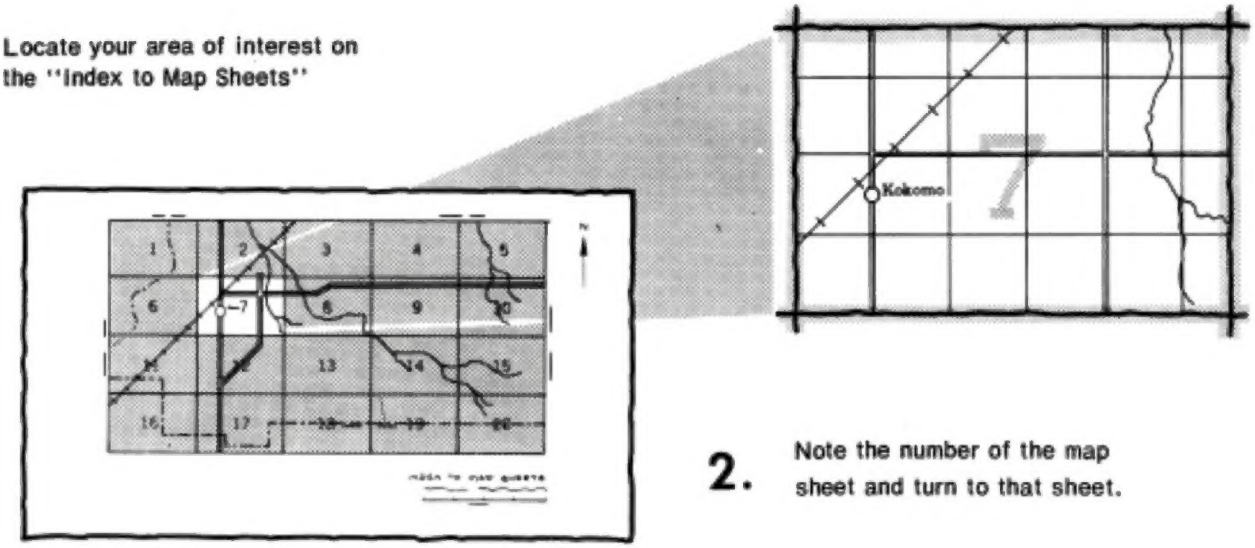
SOIL SURVEY OF

Douglas County, Washington

United States Department of Agriculture
Soil Conservation Service
in cooperation with the Washington State University
Agricultural Research Center

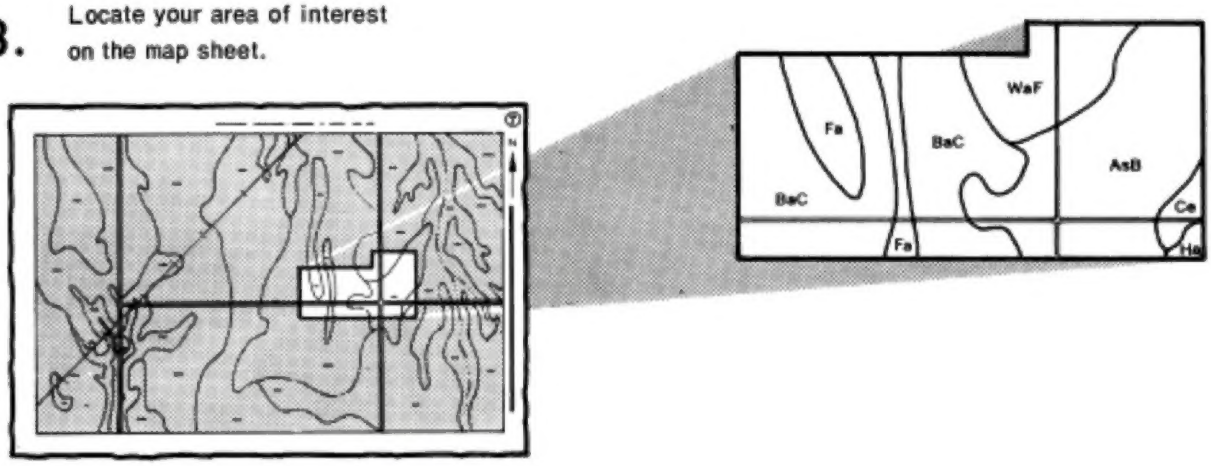
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

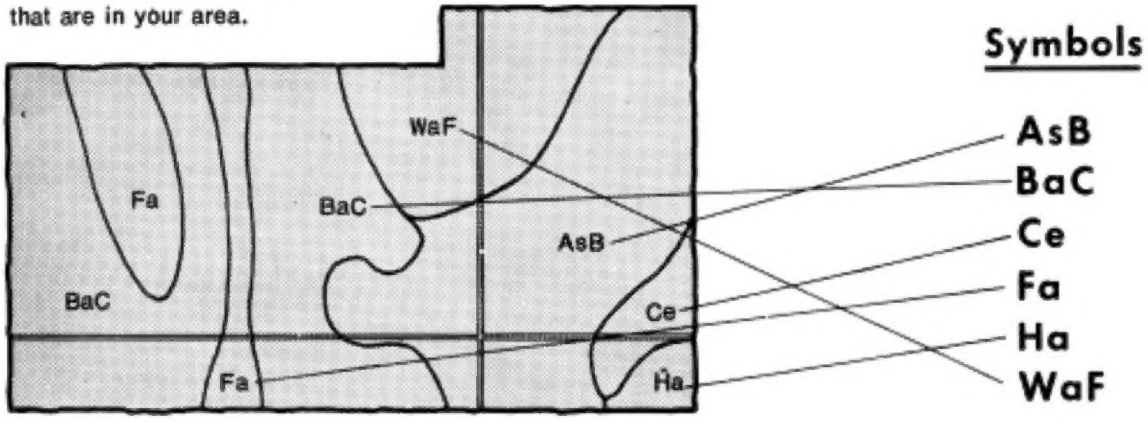


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

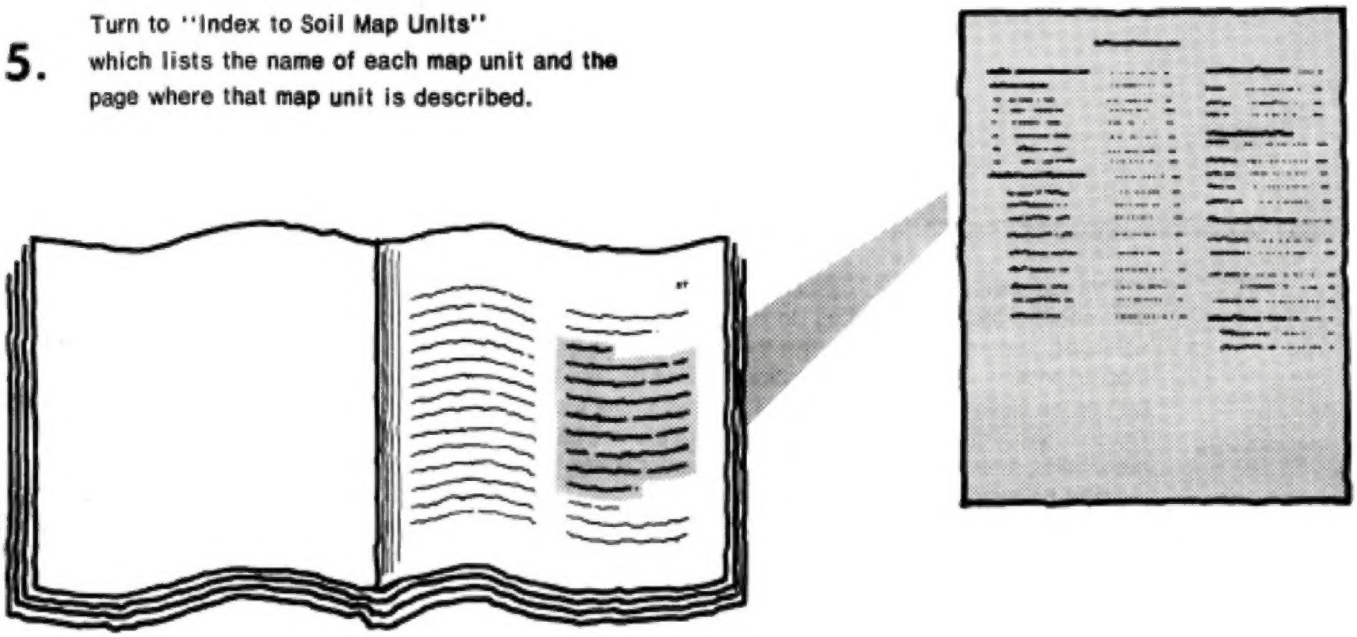


4. List the map unit symbols that are in your area.

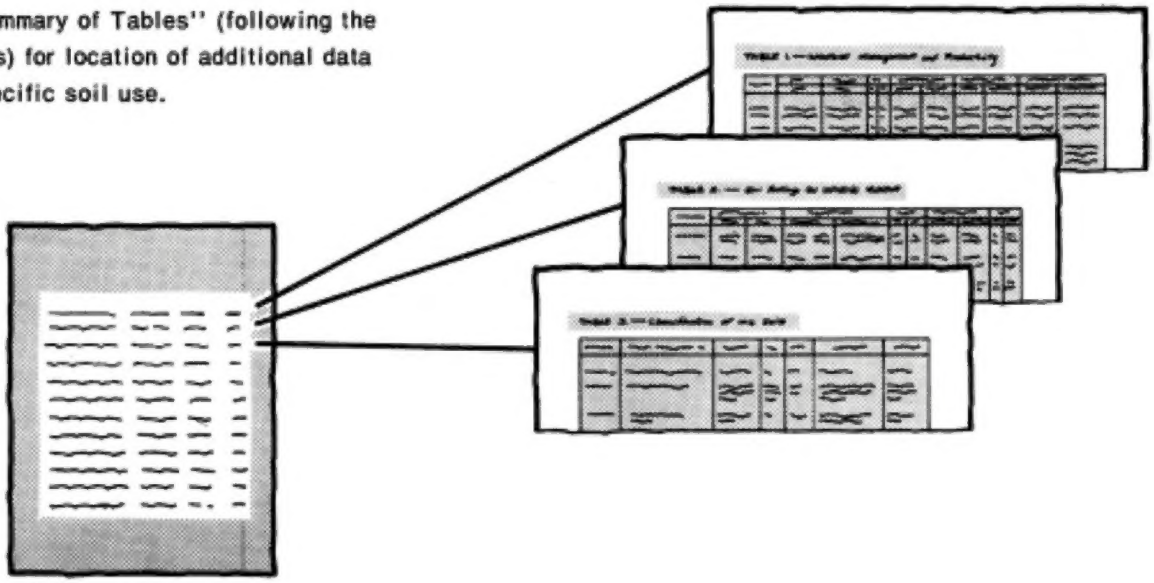


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1970 to 1977. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978. This survey was made cooperatively by the Soil Conservation Service and the Washington State University, Agricultural Research Center. It is part of the technical assistance furnished to the South Douglas Conservation District and the Foster Creek Conservation District.

Cover: View of Badger Mountain in western Douglas County. Nonirrigated cropland in foreground is Broadax silt loam.

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Issued November 1981

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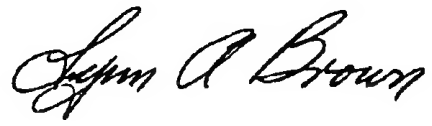
foreword

This soil survey contains information that can be used in land-planning programs in Douglas County, Washington. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.



Lynn A. Brown
State Conservationist
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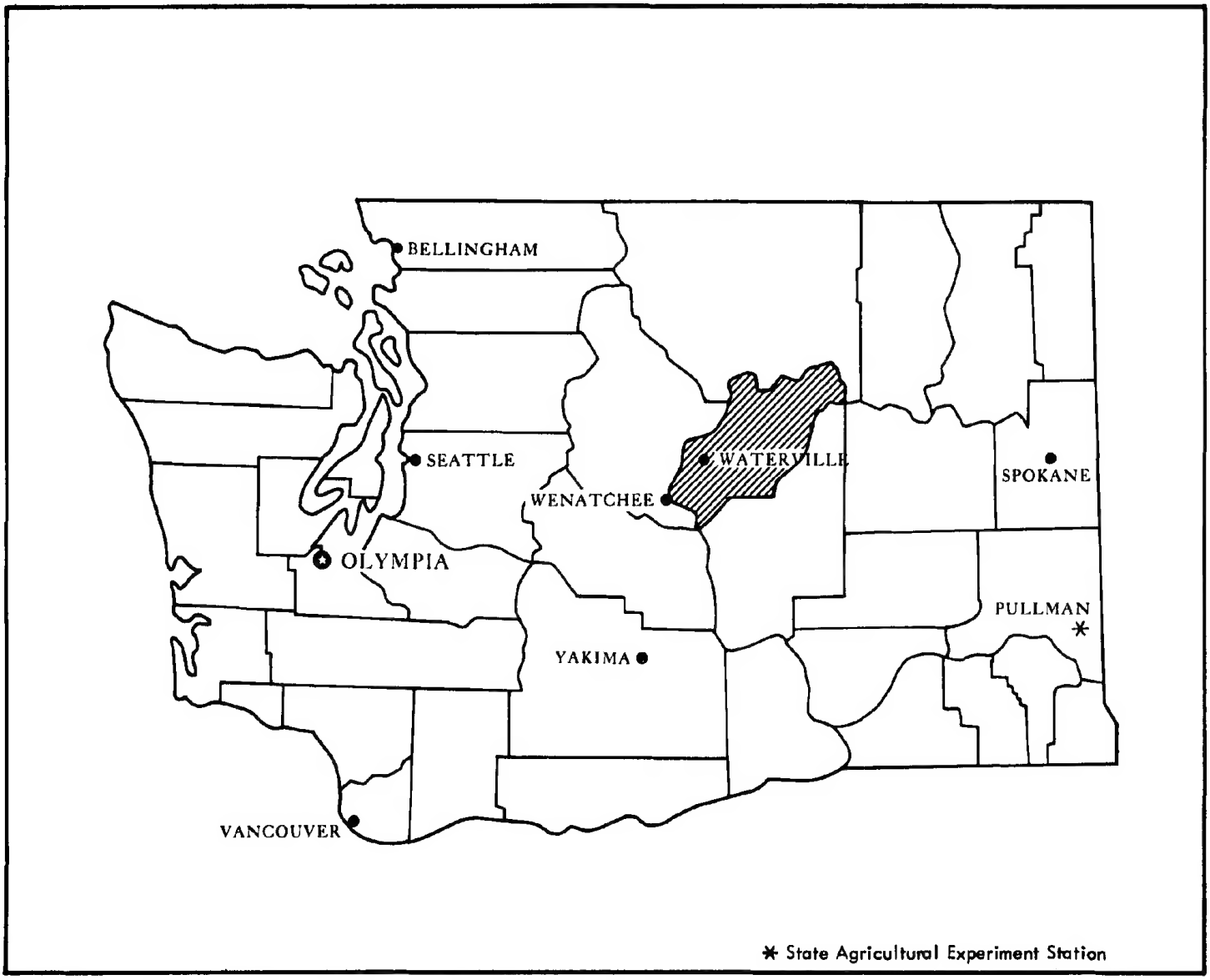

Location of Douglas County in Washington.

soil survey of
Douglas County, Washington

By Vern E. Beieler, Soil Conservation Service

Soils surveyed by Vern E. Beieler, Frank L. Nelson, Charles D. Lenfesty, Loren L. Main, Phillip P. McColley, and Sandford Anderson, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
in cooperation with
the Washington State University, Agricultural Research Center

DOUGLAS COUNTY is in the central part of Washington in the great bend area of the Columbia River. It covers a total of 1,172,280 acres, or 1,832 square miles.

The river has cut a rather deep gorge along the northern and western boundaries of the county. In most places along the river, there are a series of nearly level to gently sloping terraces. Long, steep side slopes lead from these terraces to a broad upland plateau. This plateau, underlain by basalt, occupies most of the county. It has undulating and rolling topography and is interspersed by intermittent drainages; Moses Coulee (fig. 1) is a valley that extends to the southwest in the southern part of the county. Elevation in the county ranges from 570 feet in the southwestern corner to 4,255 feet on top of Badger Mountain, a geologic uplift along the western side.

general nature of the county

Douglas County, originally part of Spokane and then Lincoln County, was formed in 1883. Waterville, population 945, is the county seat.

Farming began in the 1870's, and most of the county was settled in the 1880's. During the very dry late 1920's most of the dryland wheat farms sustained moderate to severe wind erosion. By the mid 1930's this erosion had been reduced, largely as a result of more rainfall and better methods of cultivation. Each year as better methods of tillage are developed and applied, less water and wind erosion generally occur.

Douglas County is now approximately 48 percent cropland and 49 percent rangeland. The remaining area is in woodland, wildlife habitat, urban and suburban land, roads, and railroads. About 23,900 acres of the cropland is irrigated, mostly for apple orchards. The remaining cropland is mostly in dryland summer-fallow wheat production. Most of the rangeland is operated in conjunction with the nonirrigated wheat farms. Woodland is limited to about 8,000 acres, mostly on the north slope of Badger Mountain and in scattered stands of Douglas-fir and pine in Pine Canyon.

Four large hydroelectric dams—Chief Joseph, Wells, Rocky Reach, and Rock Island—are located on the Columbia River and are partially in Douglas County. These dams provide a large amount of water storage and electricity for the Pacific Northwest.

The town of East Wenatchee, in the western part of the county, has grown rapidly. Housing developments have increased greatly in the past several years, and schools and businesses are also expanding. There is a large mineral processing plant just to the south of East Wenatchee. A beautiful view of the Cascade Mountains is available to the west from almost anywhere in this area.

Golfing, hunting, fishing, camping, swimming, sports car racing, and boating are popular summer recreation activities in the area. In winter, there is skiing at the Badger Mountain ski area, snowmobiling, and dogsled racing.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

The Rocky Mountains partly shield Douglas County from strong Arctic winds. As a result, winters are cold but generally not too severe. In summer, Pacific Ocean winds are partly blocked; days are hot, but nights are fairly cool. Precipitation, except in mountainous areas, is

Figure 1.—View up Moses Coulee toward the east. Esquatzel loam is in center foreground. Kiona-Rubble land association, steep, and Rubble land-Rock outcrop complex are on the left and right sides of the landscape.

scant in summer, but in many places it is adequate during the cooler parts of the year for nonirrigated small grains or range plants. Snowpack accumulation at high elevations supplies irrigation water for intensive agriculture in parts of the lowland.

Tables 1 and 2 give data on temperature and precipitation for the survey area as recorded at Waterville and Wenatchee, Wash., for the period 1951 to 1977. The Waterville records give good data for the upland plateau part of the county, and the Wenatchee records give good data for the lower, irrigated orchardland part of the county. Tables 3 and 4 show probable dates of the first freeze in fall and the last freeze in spring for these two locations. Tables 5 and 6 provide data on the growing seasons.

In winter the average temperatures at Waterville and Wenatchee are 26 and 32 degrees F, respectively. The average daily minimum temperature is 17 degrees at Waterville and 25 degrees at Wenatchee. The lowest temperature, -33 degrees, occurred at Waterville on December 30, 1968. In summer the average temperature is 65 degrees at Waterville and 71 degrees at Wenatchee. The average daily maximum temperature is about 83. The highest recorded temperature, 106 degrees, occurred at Wenatchee on July 31, 1971.

Growing degree days, shown in tables 1 and 2, are equivalent to heat units. During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation can be used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall. It can also help in planning harvest dates.

The total annual precipitation is 11 inches at Waterville and 9 inches at Wenatchee. Of this, 35 percent usually falls in April through September, which includes the growing season for most crops. The heaviest 1-day rainfall during the period of record was 2.72 inches at Wenatchee on August 18, 1975. Thunderstorms occur on about 7 days each year, mostly in summer.

Average seasonal snowfall is 51 inches at Waterville and 33 inches at Wenatchee. The greatest snow depth

at any one time during the period of record was 45 inches at Waterville. On the average, 22 to 25 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 45 percent. Humidity is higher at night, and the average at dawn is about 75 percent. The percentage of possible sunshine is 70 in summer and 30 in winter. The prevailing wind is from the west-northwest. Average windspeed is highest, 9 miles per hour, in spring.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

soil descriptions

1. Pogue-Quincy-Xerorthents, very steep

Very deep, somewhat excessively drained, nearly level to very steep soils; on terraces and terrace escarpments

This map unit borders the Columbia River along the northern and western parts of the county. Slope is 0 to 65 percent. The vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,800 feet. The average annual precipitation is about 7 to 12 inches, the average annual air temperature is about 51 degrees F, and the frost-free season is 135 to 180 days.

This unit covers about 4 percent of the survey area. It is about 20 percent Pogue soils, 15 percent Quincy soils, and 15 percent Xerorthents, very steep. The remaining 50 percent is soils of minor extent.

Pogue soils are on terraces. They formed in alluvium mixed with loess overlying glacial outwash. They have a fine sandy loam surface layer. The subsoil is cobbly fine sandy loam in the upper part and extremely gravelly sandy loam in the lower part. The substratum is very cobbly sand to a depth of 60 inches or more.

Quincy soils are on terraces. They formed in eolian materials. They have a loamy fine sandy surface layer and fine sand underlying material to a depth of 60 inches or more.

Xerorthents, very steep, are on terrace escarpments. They formed in glacial outwash mixed with loess in the upper part. They have a gravelly fine sandy loam surface layer, and the underlying material is very cobbly sand to a depth of 60 inches or more. Texture varies widely within short distances.

Of minor extent in this unit are well drained Burch, Cashmere, Cashmont, Ellisforde, and Supplee soils and Xerofluvents, nearly level. Also included are somewhat excessively drained Beverly, Magallon, and Malaga soils and excessively drained Burbank soils.

This unit is used mainly for irrigated orchards. It is also used for irrigated hay and pasture, rangeland, and wildlife habitat.

2. Bakeoven-Rock Creek-Lickskillet

Shallow, well drained, gently sloping to moderately steep soils; on basalt uplands and plateaus, mountain side slopes, and ridgetops

This map unit is in the southern part of the county. Slope is 3 to 30 percent. The vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,000 to 4,200 feet. The average annual precipitation is about 7 to 15 inches, the average annual air temperature is 47 to 50 degrees F, and the average frost-free season is 120 to 170 days.

This unit covers about 21 percent of the survey area. It is about 25 percent Bakeoven soils, 10 percent Rock Creek soils, and 10 percent Lickskillet soils. The remaining 55 percent is soils of minor extent.

Bakeoven soils are on basalt plateaus. They formed in colluvium from basalt and alluvium mixed with loess. They have a very cobbly loam surface layer and a very gravelly loam and very gravelly clay loam subsoil over basalt. Depth to the basalt ranges from 4 to 12 inches.

Rock Creek soils are on mountain side slopes and ridgetops. They formed in residuum from basalt mixed with loess. The surface layer is very cobbly silt loam. The subsoil is very gravelly clay and extremely cobbly clay over basalt. Depth to basalt ranges from 8 to 20 inches.

Lickskillet soils are on broad basalt uplands and canyon side slopes. They formed in weathered basalt mixed with loess and colluvium. The surface layer is cobbly silt loam, and the subsoil is very gravelly silt loam over basalt. Depth to the basalt ranges from 12 to 20 inches.

Of minor extent in this unit are the Badge, Broadax, Condon, Entiat, Finley, Kiona, Ralls, Renslow, Strat, and Zen soils. Some areas of Rock outcrop and Rubble land are also included.

This unit is used mainly for rangeland and wildlife habitat.

3. Dinkels-Cordy

Very deep and deep, well drained, undulating to very steep soils; on mountain slopes and on side slopes

This map unit is on north slopes of Badger Mountain and on the side slopes of the uplands along the western part of the county. Slope is 3 to 70 percent. The vegetation is mainly conifer trees, brush, and grass. Elevation is 800 to 4,200 feet. The average annual precipitation is 12 to 15 inches, the average annual air temperature is 44 to 46 degrees F, and the average frost-free season is 90 to 140 days.

This unit covers about 2 percent of the survey area. It is about 40 percent Dinkels soils and 35 percent Cordy soils. The remaining 25 percent is soils of minor extent.

Dinkels soils are on side slopes and low mountain slopes. They formed in colluvium mixed with loess and volcanic ash. They are deep and have a gravelly loam surface layer. The upper part of the subsoil is gravelly sandy loam and the lower part is very gravelly coarse sandy loam over granite. Depth to the granite ranges from 40 to 60 inches.

Cordy soils are mostly on mountain slopes on the north side of Badger Mountain. They formed in loess mixed with volcanic ash. They are very deep and have a loam surface layer and loam and silt loam subsoil and substratum.

Of minor extent in this unit are Badge, Condon, Entiat, and Rock Creek soils.

This unit is used mainly for rangeland, woodland, and wildlife habitat.

4. Renslow-Zen

Very deep and moderately deep, well drained, nearly level to moderately steep soils; on broad basalt plateaus

This map unit is in the southern part of the county. Slope is 0 to 30 percent. The vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 3,200 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 140 to 180 days.

This unit covers about 19 percent of the survey area. It is about 55 percent Renslow soils and 25 percent Zen soils. The remaining 20 percent is soils of minor extent.

Renslow soils are very deep. They formed in loess and the texture is silt loam to a depth of 60 inches or more.

Zen soils are moderately deep. They formed in loess and have a silt loam surface layer and subsoil over basalt. Depth to basalt ranges from 20 to 40 inches.

Of minor extent in this unit are Broadax, Chelan, Condon, Dougville, and Esquatzel soils.

This unit is used mainly for nonirrigated cropland. Winter wheat is grown in a wheat-fallow cropping system.

5. Touhey-Heytou

Very deep, well drained, nearly level to moderately steep soils; on broad uplands and basalt plateaus

This map unit is in the northern half of the county. Slope is 0 to 30 percent. The vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,000 to 3,000 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 135 to 165 days.

This unit covers about 39 percent of the survey area. It is about 60 percent Touhey soils and 30 percent Heytou soils. The remaining 10 percent is soils of minor extent.

Touhey soils are on broad basalt plateaus and uplands. They formed in glacial till mixed with loess in the upper part. They have a loam surface layer and gravelly loam subsoil. The substratum is gravelly loam to a depth of 60 inches or more with discontinuous cemented lenses of lime and silica less than 1/8 inch thick at a depth of about 28 inches. Depth to the cementation ranges from 20 to 36 inches.

Heytou soils are on basalt uplands. They formed in glacial till mixed with loess in the upper part. They have a very stony loam surface layer. The subsoil and substratum are very cobbly loam to a depth of 60 inches or more.

Of minor extent in this unit are Aquolls, nearly level; Haploxerolls, nearly level; and Umapine Variant soils. Also included are Chelan, Ellisforde, and Timentwa soils.

This unit is used mainly for nonirrigated cropland. Winter wheat is grown in a wheat-fallow cropping system. This unit is also used for rangeland and wildlife habitat.

6. Willis

Moderately deep, well drained, nearly level to moderately steep soils; on basalt plateaus

This map unit is in the southern part of the county. Slope is 3 to 15 percent. The vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 3,000 feet. The average annual precipitation is about 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 140 to 180 days.

This unit covers about 5 percent of the survey area. It is about 85 percent Willis soils. The remaining 15 percent is soils of minor extent.

Willis soils formed in loess. They have a silt loam surface layer, subsoil, and substratum over an indurated duripan. Depth to the duripan ranges from 20 to 40 inches.

Of minor extent in this unit are Lickskillet, Renslow, and Zen soils.

This unit is used mainly for nonirrigated cropland. Winter wheat is grown in a wheat-fallow cropping system.

7. Bakeoven-Touhey

Shallow and very deep, well drained, nearly level to steep soils; on basalt plateaus and uplands

This map unit is in the northern part of the county. Slope is 0 to 25 percent. The vegetation on this unit is mainly grasses, forbs, and shrubs. Elevation is 1,000 to 3,200 feet. The average annual precipitation is 7 to 12 inches, the average annual air temperature is 49 to 50 degrees F, and the average frost-free season is 135 to 165 days.

This unit covers about 10 percent of the survey area. It is about 60 percent Bakeoven soils and 20 percent Touhey soils. The remaining 20 percent is soils of minor extent.

Bakeoven soils are on basalt plateaus. They are shallow and formed in colluvium from basalt and alluvium mixed with loess. They have a very cobbly loam surface layer and a very gravelly loam and very gravelly clay loam subsoil over basalt. Depth to the basalt ranges from 4 to 12 inches.

Touhey soils are on basalt plateaus and uplands. These soils are very deep. They formed in glacial till mixed with loess in the upper part. They have a loam surface layer and gravelly loam subsoil. The substratum is gravelly loam to a depth of 60 inches or more with discontinuous cemented lenses of lime and silica less than 1/8 inch thick at a depth of about 28 inches. Depth to the cementation ranges from 20 to 36 inches.

Of minor extent in this unit are the very poorly drained Aquolls, nearly level, and moderately well drained Haploxerolls, nearly level. Also included are the well drained Heytou, Lickskillet, Ralls, and Strat soils.

This unit is used mainly for rangeland and wildlife habitat.

broad land use considerations

The soils of Douglas County vary widely in their suitability for major land uses. Approximately 48 percent of the land in the county is used for cropland, mainly nonirrigated cropland. This cropland is scattered throughout the county, but is concentrated largely in general soil map units 1, 4, 6, and part of 5. The irrigated land is mostly terraces along the Columbia River in general soil map unit 1. Soils in general soil map units 4, 5, and 6 are on the broad upland plateau and are used for nonirrigated crops. The main soils in these units are Broadax, Renslow, Touhey, Willis, and Zen soils. Aquolls, nearly level; Haploxerolls, nearly level; and Esquatzel soils in these units have a wetness or flooding hazard that limits the type of crops grown.

Approximately 49 percent of the county is range. Soils in general soil map units 2, 7, and part of 5 are suited to grasses and forbs for grazing. The major soils in these units are Bakeoven, Lickskillet, Heytou, and Rock Creek soils. These soils are on the upland plateau or on the slopes leading to the plateau.

About 1 percent of the land is woodland, concentrated in general soil map unit 3. The productivity for Douglas-fir and ponderosa pine is good on the Cordy soils, which are mostly on the north side of Badger Mountain.

The rest of the land in the county is mainly urban. Deciding which land should be used for urban development is an important issue in parts of Douglas County. Each year a considerable amount of land in general soil map unit 1 is developed for urban uses in East Wenatchee. The general soil map can be used when considering broad land use, and the detailed soil maps at the end of this report can be used to help select more specific areas for urban structures. In general, soils that are well suited to cultivated crops are also well suited to urban development. The value of prime agricultural land however, should not be overlooked when land uses are considered. Data about specific soils can be helpful in planning future land use patterns.

Areas where soil properties prohibit urban development are mostly to the east of East Wenatchee in general soil map unit 1. Xerorthents, very steep, and soils in general soil map unit 2 have severe limitations for building sites and sewage disposal because of the steep slope and shallow depth. Many soils in general soil map unit 1 along the Columbia River and around East Wenatchee, Orondo, and Bridgeport have a very gravelly and sandy substratum. This could result in contamination of ground water or nearby streams if care is not taken in establishing septic tank absorption fields.

The suitability of the soils for recreation uses ranges from low to high depending on the intensity of the expected use and the properties of the soil. Most of the soils in general soil map unit 1 are well suited to recreational development. Soils in general soil map units 2 and 7 generally are poorly suited because of the shallow depth to bedrock. The main limitation of soils in general soil map unit 3 is the steepness of slope. Soils in general soil map units 4, 5, and 6 are generally suited to recreation.

The suitability of the soils for wildlife habitat varies throughout the county. Soils in general soil map units 2, 4, 5, 6, and 7 are suited to openland wildlife; soils in unit 3 are suited to woodland wildlife. Orchard sprays have detrimental effects and limit the wildlife habitat in general soil map unit 1. Several soils in the county such as Aquolls, nearly level, and Haploxerolls, nearly level, are suited to wetland wildlife.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Pogue fine sandy loam, 0 to 3 percent slopes, is one of several phases in the Pogue series.

Some map units are made up of two or more major soils. These map units are called soil complexes and soil associations.

A *soil complex* consists of two or more soils (or miscellaneous areas) in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Entiat-Rock outcrop complex, steep, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Condon-Rock Creek-Broadax association, gently sloping, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rubble land-Rock outcrop complex is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 7 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

This survey was mapped at two levels of detail. At the most detailed level, map units are narrowly defined. This means that soil boundaries were plotted and verified at closely spaced intervals. At the less detailed level, map units are broadly defined. Soil boundaries were plotted and verified at wider intervals. The broadly defined units are indicated by an asterisk in the soil map legend. The detail of mapping was selected to meet the anticipated long-term use of the survey, and the map units were designed to meet the needs for that use.

soil descriptions

10—Aquolls, nearly level. This moderately deep to deep, very poorly drained to somewhat poorly drained soil is on the basalt plateau. It formed in alluvium mixed with loess. Slope is 0 to 2 percent. It occupies rather large level bottoms of depressions or potholes and nearly level areas near streams and drainageways. Native vegetation is mainly grass and brush. Elevation is 2,500 to 3,000 feet. The average annual precipitation is about 9 to 15 inches, mean annual air temperature is about 49 degrees F, and the frost-free season is 110 to 165 days.

No one pedon represents this map unit but in one of the more common ones the surface layer is grayish brown and brown loam about 18 inches thick. The subsoil is pale olive silt loam about 6 inches thick over a

weakly cemented hardpan at a depth of about 24 inches. Depth to the hardpan ranges from 22 to 50 inches. This soil is moderately to very strongly alkaline. Texture varies widely within short distances.

Included with this soil in mapping are areas of Broadax, Touhey, and Umapine Variant soils that make up 20 percent of the unit. Also included are areas of Haploxerolls, nearly level, and a few areas of open water.

Permeability of these Aquolls is moderately slow. Available water capacity is moderate. Effective rooting depth is 22 to 50 inches for water-tolerant plants and 10 to 20 inches for water-sensitive plants. Surface runoff is ponded, and the hazard of water erosion is slight. Depth to the seasonal high water table ranges from 6 inches in spring to more than 5 feet during the fall. In most lower areas of the unit the water table is within 1 1/2 feet of the surface. These areas are commonly flooded in the spring and after heavy rains.

This soil is used mainly for rangeland and wildlife habitat.

The potential native vegetation is inland saltgrass, alkali bluegrass, rush, basin wildrye, and greasewood. Management of the vegetation should be designed to increase production of the grasses. Proper grazing will improve deteriorated range. Mechanical brush management or seeding is also practical. Adapted species should be seeded. For best results, the seedbed should be properly prepared and a grass drill used.

This soil is in capability subclass VIw, nonirrigated.

11—Badge very cobbly silt loam, 25 to 65 percent slopes. This very deep, well drained soil is on side slopes of canyons and drainageways. It formed mainly in colluvium mixed with loess. Native vegetation is mainly grasses and sagebrush. Elevation is 3,000 to 4,000 feet. The average annual precipitation is 12 to 14 inches, mean annual air temperature is about 47 degrees F, and the frost-free season is 110 to 150 days.

Typically, the surface layer is dark grayish brown very cobbly silt loam about 8 inches thick in the upper part and brown very gravelly silt loam about 5 inches thick in the lower part. The subsoil is yellowish brown extremely cobbly clay loam about 15 inches thick. The substratum is light yellowish brown very cobbly heavy silt loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are areas of Condon, Ralls, and Rock Creek soils and areas of Rock outcrop and Rubble land. These areas make up as much as 20 percent of the unit. Also included are areas of Badge soils with rolling topography on the lower slopes.

Permeability of this Badge soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly for rangeland and wildlife habitat.

Slope and the very cobbly surface layer are the main limitations of this unit for rangeland.

The potential native vegetation is bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. Management of the vegetation should be designed to increase production of the bluebunch wheatgrass. Proper grazing management will improve deteriorated range. Brush management by mechanical means is difficult because of steep slopes and cobbles on the surface. Other practices suitable for this soil are deferred grazing, rotation grazing systems, and water development.

This soil is in capability subclass VIIs, nonirrigated.

12—Bakeoven-Lickskillet association, gently sloping. This unit is on broad basalt plateaus or uplands. The soils formed in material weathered from basalt mixed with loess. This unit occurs in areas adjacent to canyon rims and drainageways. Slopes are 3 to 25 percent. Elevation is 1,500 to 3,200 feet. Native vegetation is mainly bunchgrass and sagebrush. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 140 to 210 days.

This unit is about 50 percent Bakeoven very cobbly silt loam, 3 to 25 percent slopes, and 15 percent Lickskillet cobbly silt loam, 3 to 25 percent slopes. The Bakeoven soil is immediately adjacent to canyon rims, rock outcrops, and drainageways.

Included in mapping are areas of Bakeoven soils with slopes of more than 25 percent. These areas make up as much as 15 percent of the unit. Also included are areas of Rock outcrop and Rubble land that make up 10 percent of the unit and areas of Kiona, Ralls, Renslow, Strat, and Zen soils that make up another 10 percent.

The Bakeoven soil is shallow and well drained. Typically, it has a brown very cobbly loam surface layer about 4 inches thick. The subsoil is yellowish brown very gravelly loam and very gravelly clay loam about 5 inches thick over basalt. Depth to the basalt ranges from 4 to 12 inches.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is low. Effective rooting depth is 4 to 12 inches. Surface runoff is medium, and the hazard of water erosion is moderate.

The Lickskillet soil is shallow and well drained. Typically, it has a brown, cobbly silt loam surface layer 4 inches thick. The subsoil is yellowish brown very gravelly heavy silt loam 14 inches thick over basalt. Depth to the basalt ranges from 12 to 20 inches.

Permeability of this Lickskillet soil is moderate. Available water capacity is low. Effective rooting depth is 12 to 20 inches. Surface runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for rangeland and wildlife habitat.

The main limitation of this unit for rangeland is the shallow rooting depths and cobbles on the soil surface.

The potential native vegetation on the Bakeoven soil is mainly Sandberg bluegrass and stiff sagebrush. The potential native vegetation on the Lickskillet soil is mainly

bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and stiff sagebrush. The management of vegetation should be designed to increase production of Sandberg bluegrass on the Bakeoven soil and bluebunch wheatgrass on the Lickskillet soil. Brush management by aerial spraying and proper grazing will improve deteriorated range on this unit. Mechanical brush management is not practical because of the cobbles on the surface. Management practices suitable for this unit are proper grazing, deferred grazing, and rotation grazing after adequate water development.

Both the Bakeoven soil and the Lickskillet soil are in capability subclass VIIs, nonirrigated.

13—Bakeoven-Touhey association, gently sloping. This unit is on basalt plateaus and broad uplands. The soils formed in material weathered from basalt or glacial till mixed with loess. Slope is 0 to 25 percent. Native vegetation is mainly grass and sagebrush. Elevation is 2,000 to 2,400 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 49 degrees F, and the frost-free season is 135 to 165 days.

This unit is about 60 percent Bakeoven very cobbly loam, 3 to 25 percent slopes, and 20 percent Touhey loam, 0 to 15 percent slopes. Slope on the Bakeoven soil is dominantly 3 to 25 percent, but ranges as high as 45 percent. The Bakeoven soil is on plateaus and side slopes leading down into depressions and pothole ponds. The Touhey soil is mostly in small biscuitlike mounds, but is also in long narrow stringers and other small areas.

Included in mapping are areas of Aquolls, nearly level; Heytou, Lickskillet, Ralls, and Strat soils; Rubble land; Rock outcrop; ponds; and intermittent ponds.

Typically, the Bakeoven soil is shallow and well drained. It has a brown, very cobbly loam surface layer about 4 inches thick. The subsoil is yellowish brown very gravelly clay loam about 5 inches thick over basalt. Depth to the basalt ranges from 4 to 12 inches.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is low. Effective rooting depth is 4 to 12 inches. Surface runoff is medium, and the water erosion hazard is moderate.

Typically, the Touhey soil is very deep and well drained. It has a brown, loam surface layer about 10 inches thick. The subsoil is yellowish brown gravelly loam 9 inches thick. The upper part of the substratum is gray gravelly loam about 9 inches thick over discontinuous cemented lenses of lime and silica less than 1/8 inch thick. The lower part of the substratum is gray gravelly loam to a depth of 60 inches or more. Depth to the cementation ranges from 20 to 36 inches.

Permeability of the Touhey soil is moderate above the cementation and moderately slow through it. Available water capacity is moderate. Effective rooting depth is restricted by the cementation at a depth of 20 to 36 inches. Surface runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for rangeland and wildlife habitat.

The main limitation of this unit for rangeland is the shallow rooting depth and very cobbly surface layer of the Bakeoven soil.

The potential native vegetation is mainly Sandberg bluegrass and stiff sagebrush on the Bakeoven soil. Management of the vegetation on the Bakeoven soil should be designed to maintain production of the Sandberg bluegrass. The potential native vegetation on the Touhey soil is bluebunch wheatgrass, needleandthread, big sagebrush, balsamroot, rabbitbrush, and perennial forbs. Management of the vegetation on the Touhey soil should be designed to increase production of bluebunch wheatgrass and needleandthread. Brush management on deeper soils by aerial spraying will improve deteriorated range in this unit. Mechanical brush management is not generally practical because of the cobbles on the surface of the Bakeoven soil. Management practices suitable for this unit are proper grazing, deferred grazing, and rotation grazing.

The Bakeoven soil is in capability subclass VIIs, nonirrigated, and the Touhey soil is in IIIe, nonirrigated.

14—Beverly fine sandy loam, 0 to 8 percent slopes. This very deep, somewhat excessively drained soil is on low terraces immediately above rivers and streams and on fans. It formed in recent alluvium. Individual areas of this unit are somewhat circular in shape and range in size from 4 to 20 acres. Native vegetation is mainly grass and shrubs. Elevation is 2,000 to 2,400 feet. The average annual precipitation is about 8 to 12 inches, the mean annual air temperature is about 50 degrees F, and the frost-free season is 150 to 185 days.

Typically, the surface layer is grayish brown fine sandy loam about 5 inches thick. The upper part of the substratum is light brownish gray gravelly fine sandy loam and pale brown very gravelly sandy loam about 15 inches thick. The lower part of the substratum is multicolored extremely gravelly loamy coarse sand to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Burbank, Cashmont, and Pogue soils. Also included are areas that have a loamy fine sand, cobbly fine sandy loam, or very gravelly loamy fine sand surface layer and small areas that have slopes of more than 8 percent.

Permeability of this Beverly soil is moderately rapid to a depth of about 20 inches and very rapid below that. Available water capacity is low. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is slight. This soil is subject to rare flooding during summer storms and spring runoff. The surface layer is very friable and easily tilled. There is a high hazard of soil blowing.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches,

apricots, and cherries are also grown. A few areas are used for irrigated hay, pasture, and homesites.

The main limitations of this soil for irrigated crops are soil droughtiness and the hazard of soil blowing.

Perennial cover crops can reduce soil blowing. Cover crops also improve fertility, reduce crusting, and increase water infiltration.

Sprinkler irrigation is the most suitable method of applying water. At the peak of the growing season, about 2.4 inches of water should be applied every 8 days at a rate of 0.5 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. Because this soil is droughty, light and frequent applications of water are needed.

Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

Flooding is the main limitation for homesites. Diversion ditches and dikes reduce flooding but must be carefully evaluated and designed. This soil is a poor filter for septic tank absorption fields.

This soil is in capabilty subclass IVe, irrigated.

15—Beverly cobbly fine sandy loam, 0 to 8 percent slopes. This very deep, somewhat excessively drained soil is on low terraces immediately adjoining streams and on fans. It formed in recent alluvium. Individual areas of this unit are somewhat oblong to irregular in shape and range in size from 2 to 40 acres. The native vegetation is mainly grass and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is about 8 to 12 inches, the mean annual air temperature is about 50 degrees F, and the frost-free season is 150 to 185 days.

Typically, the surface layer is grayish brown cobbly fine sandy loam about 5 inches thick. The upper substratum is light brownish gray gravelly fine sandy loam and pale brown very gravelly sandy loam about 15 inches thick. The lower substratum is multicolored extremely gravelly loamy coarse sand to a depth of 60 inches or more.

Included with this soil in mapping are small areas with very gravelly loamy fine sand, loamy fine sand, or fine sandy loam surface layers.

Permeability of this Beverly soil is moderately rapid to a depth of about 20 inches and very rapid below that. Available water capacity is low. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is slight. This soil is subject to rare flooding during summer storms and spring runoff. The surface layer is very friable and can be tilled through a wide range in moisture content. There is a high soil blowing hazard.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are also used for irrigated hay, pasture, and homesites.

When used for irrigated orchards the main limitations are soil droughtiness, cobbles on the surface, and the soil blowing hazard.

Cover crops can help prevent soil blowing. Cover crops also improve fertility, reduce crusting, and increase water infiltration. Care is needed when cutting the cover crop or mowing hay because the cobbles on the surface can damage equipment.

This soil has a low available water capacity. During the growing season about 2.0 inches of water should be applied every 6 days at a rate of 0.5 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. Because this soil is droughty, light and frequent applications of water are needed.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

Flooding is the main soil limitation for homesites. Diversion ditches and dikes reduce flooding but must be carefully evaluated and designed. This soil is a poor filter for septic tank absorption fields.

This soil is in capabilty subclass IVe, irrigated.

16—Broadax-Condon association, rolling. This unit is on basalt plateaus. It formed in loess. Slope is 0 to 15 percent. Native vegetation is mainly grass and sagebrush. Elevation is 2,400 to 4,000 feet. The annual precipitation is about 12 to 15 inches, mean annual air temperature is about 47 degrees F, and the frost-free season is 110 to 150 days.

This unit is about 65 percent Broadax silt loam, 0 to 15 percent slopes, and 15 percent Condon silt loam, 0 to 15 percent slopes. The Broadax soil occurs throughout the unit. The Condon soil occurs mostly near the outer edges of the unit.

Included in mapping are areas of Broadax and Condon soils with slopes of 15 to 30 percent. These included areas of Broadax soils make up 5 percent of the unit; the Condon soils make up another 5 percent. Also included are areas of Cordy, Renslow, Rock Creek, and Zen soils that make up 10 percent of the unit.

Typically, the Broadax soil is very deep and well drained. It has a grayish brown, silt loam surface layer about 13 inches thick. The subsoil is pale brown silty clay loam and yellowish brown heavy silt loam about 22 inches thick. The substratum is pale brown silt loam to a depth of 60 inches or more.

Permeability of this Broadax soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate.

Typically, the Condon soil is moderately deep and well drained. It has a grayish brown, silt loam surface layer

about 7 inches thick. The subsoil is brown and pale brown silt loam about 27 inches thick over basalt. Depth to the basalt ranges from 20 to 40 inches.

Permeability of this Condon soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the water erosion hazard is moderate.

This soil is used mainly for nonirrigated cropland and wildlife habitat. A few areas are rangeland.

The main crop is winter wheat in a summer-fallow system. Precipitation is generally too low for annual cropping. Early fall seeding, stubble mulch tillage, and grassed waterways can reduce erosion. Terraces, diversions, and stripcropping, used singly or in combination, can also reduce erosion.

Potential native vegetation on this unit is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and threetip sagebrush. Management of vegetation should be designed to increase production of bluebunch wheatgrass and Idaho fescue. Management practices suitable for this unit are proper grazing, deferred grazing, and rotation grazing along with water development. Mechanical brush management or aerial spraying and proper grazing can improve deteriorated range. Range seeding is suitable if the range vegetation is in poor condition. The plants selected for seeding should be adapted species. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand the anticipated intensity of grazing.

Both the Broadax and the Condon soil are in capability subclass IIIe, nonirrigated.

17—Burbank loamy fine sand, 0 to 8 percent slopes. This very deep, excessively drained soil is mainly on low terraces. It formed in alluvium and eolian deposits over glacial outwash gravel. Individual areas of this soil are somewhat oblong in shape and range in size from 2 to 30 acres. Native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is about 7 to 9 inches, mean annual temperature is about 51 degrees F, and the frost-free season is 160 to 200 days.

Typically, the surface layer is yellowish brown loamy fine sand about 6 inches thick. The upper part of the underlying material is yellowish brown gravelly loamy fine sand about 14 inches thick. The lower part of the underlying material is multicolored extremely cobbly coarse sand to a depth of 60 inches or more. Depth to the extremely cobbly coarse sand layer ranges from 14 to 27 inches.

Included with this soil in mapping are small areas of Beverly and Pogue soils and small areas that have a gravelly and very gravelly loamy sand surface layer. Also included are areas near Chief Joseph Dam that have about 3 feet of cobbly fill material over the surface.

Permeability of this Burbank soil is rapid to a depth of about 20 inches and very rapid below that. Available water capacity is low. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is slight. The soil blowing hazard is high.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. A small acreage is used for irrigated hay, pasture, and homesites. The main limitation for irrigated cropland is soil droughtiness and soil blowing.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Perennial cover crops can reduce soil blowing and improve fertility.

Sprinklers are the most suitable method of irrigation. At the peak of the growing season, 1.5 inches of water should be applied every 4 days at a rate of 0.6 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. Because this soil is droughty, light and frequent applications of water are needed.

Excessive grazing can damage the vegetation, resulting in increased soil blowing. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, and weed control can help keep the pasture and soil in good condition.

This soil is suited to homesites. The main limitation is large stones in the soil profile. This soil is a poor filter for septic tank absorption fields.

This soil is in capabilty subclass IVe, irrigated.

18—Burbank loamy fine sand, 8 to 25 percent slopes. This very deep, excessively drained soil is mainly on low terraces. It formed in alluvium and eolian deposits over glacial outwash gravel. Individual areas of this soil are somewhat oblong to irregular in shape and range in size from 3 to about 35 acres. Native vegetation is mainly grasses and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is about 7 to 9 inches, mean annual temperature is about 51 degrees F, and the frost-free season is 160 to 200 days.

Typically, the surface layer is yellowish brown loamy fine sand about 6 inches thick. The upper part of the substratum is yellowish brown gravelly loamy fine sand about 14 inches thick. The lower part of the substratum is extremely cobbly coarse sand to a depth of 60 inches or more. Depth to the extremely cobbly coarse sand layer ranges from 14 to 27 inches.

Included with this soil in mapping are small areas of Beverly, Pogue, and Quincy soils and small areas that have a gravelly loamy sand and a stony loamy fine sand surface layer. Also included are small areas that have slopes of 3 to 8 percent and areas adjoining Chief Joseph Dam that have about 3 feet of cobbly fill material over the surface.

Permeability of this Burbank soil is rapid to a depth of about 20 inches and very rapid below that. Available water capacity is low. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water

erosion hazard is moderate. The soil blowing hazard is high.

This soil is used mostly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. A small acreage is also used for irrigated hay, pasture, and homesites.

The main limitation for irrigated orchards is soil droughtiness and the soil blowing hazard.

To reduce soil blowing care should be taken not to leave areas of soil unprotected. Perennial cover crops can reduce soil blowing and water erosion and also improve fertility.

Sprinklers are the most suitable method of applying water. At the peak of the growing season 1.5 inches of water should be applied every 4 days at a rate of 0.6 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. Because this soil is droughty, light and frequent applications of water are needed.

Excessive grazing can damage the vegetation, resulting in increased runoff and soil blowing. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, and weed control can help keep the pasture and soil in good condition.

Slope is the main limitation for homesites. This soil is a poor filter for septic tank absorption fields.

This soil is in capability subclass IVe, irrigated.

19—Burch fine sandy loam, 8 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium mixed with loess. Individual areas of this soil are somewhat oblong in shape and range in size from 3 to 120 acres. Native vegetation is mainly grasses and shrubs. Elevation is 760 to 1,200 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 165 to 190 days.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is yellowish brown and light brownish gray loam about 20 inches thick. The substratum is pale brown loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Cashmere and Cashmont Variant soils. Also included are small areas that have a loam surface layer and small areas that have slopes of 15 to 25 percent.

Permeability of this Burch soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate. The soil blowing hazard is high.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

Soil blowing and slope are the main limitations for irrigated orchards.

Cover crops can reduce water erosion and soil blowing and also improve fertility, reduce crusting, and increase water infiltration.

This soil has a high available water capacity. At the peak of the growing season 4.7 inches of water should be applied every 18 days at a rate of 0.3 inch per hour for sprinkler irrigation of mature orchards. Because of the slope, sprinkler irrigation is the most suitable method of applying water. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

A compacted layer can develop in the upper part of this soil as a result of continual use of heavy orchard equipment. This compacted layer reduces water infiltration. Rotary or other types of subsoilers that penetrate to a depth of 12 inches or more, used every 2 to 4 years, can help break up this layer.

Excessive grazing can damage the vegetation and cause surface compaction, resulting in excessive runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, and weed control can help keep the pasture and soil in good condition.

Slope is the main limitation for homesites. The steepness of slope is a concern in installing septic tank absorption fields. Absorption lines should be on the contour.

This soil is in capability subclass IVe, irrigated.

20—Burch loam, 0 to 3 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium mixed with loess. Individual areas of this unit are somewhat oblong in shape and range in size from 2 to about 100 acres. Native vegetation is mainly grasses and shrubs. Elevation is 700 to 1,200 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 165 to 190 days.

Typically, the surface layer is brown loam about 10 inches thick. The subsoil is yellowish brown and light brownish gray loam about 20 inches thick. The substratum is pale brown loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Cashmere and Cashmont Variant soils and small areas that have a fine sandy loam surface layer. Also included, in depressional areas, are soils that have a clay loam surface layer and subsoil and a loamy fine sand substratum.

Permeability of this Burch soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is slight. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for homesites.

This soil is well suited to irrigated cropland. Cover crops can reduce water erosion, improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season 5.5 inches of water should be applied every 20 days at a rate of 0.25 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

A compacted layer can develop in the upper part of this soil as a result of continual use of heavy equipment. This compacted layer reduces water infiltration. Rotary or other types of subsoilers that penetrate to a depth of 12 inches or more, used every 2 to 4 years, can help break up this layer.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in excessive runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, and weed control can help keep the pasture and soil in good condition.

This soil is well suited to homesites. The restricted permeability is the main limitation for septic tank absorption fields.

This soil is in capability class I, irrigated.

21—Burch loam, 3 to 8 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium mixed with loess. Individual areas of this soil are somewhat oblong in shape and range in size from 2 to 120 acres. Native vegetation is mainly grasses and shrubs. Elevation is 700 to 1,200 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 165 to 190 days.

Typically, the surface layer is brown loam about 10 inches thick. The subsoil is yellowish brown and light brownish gray loam about 20 inches thick. The substratum is pale brown loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Cashmere and Cashmont Variant soils and small areas that have a fine sandy loam surface layer. Also included are small areas that have a clay loam surface and subsoil and a loamy fine sand substratum and small areas that have slopes of 8 to 15 percent.

Permeability of this Burch soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards (fig. 2). Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay and pasture and homesites.

This unit is suited to irrigated cropland. The main limitation is the slope.

Cover crops can reduce water erosion, improve fertility, reduce crusting, and increase infiltration.

At the peak of the growing season, 4.7 inches of water should be applied every 18 days at a rate of 0.3 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. If furrow irrigation methods are used, the furrows should be on the contour, or across the slope.

A compacted layer can develop in the upper part of this soil as a result of continual use of heavy equipment. This compacted layer reduces water infiltration. Rotary or other types of subsoilers that penetrate to a depth of 12 inches or more, used every 2 to 4 years, can help break up this layer.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in excessive runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control and restricted use during wet periods can help keep the pasture and soil in good condition.

This soil is well suited to homesites. The restricted permeability is the main limitation for septic tank absorption fields.

This soil is in capability subclass IIIe, irrigated.

22—Cashmere fine sandy loam, 0 to 3 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium mixed with loess. Individual areas of this soil are somewhat oblong in shape and range in size from 2 to about 130 acres. Native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,500 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 190 days.

Typically, the surface layer is brown fine sandy loam about 11 inches thick. The subsoil is pale brown fine sandy loam about 13 inches thick. The substratum is pale brown fine sandy loam to a depth of 60 inches or more. Some pedons are up to 10 percent pebbles.

Included with this soil in mapping are small areas of Burch, Magallon, and Quincy soils and some small areas that have a fine gravel substratum at a depth below 48 inches.

Permeability of this Cashmere soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is very slow, and the water erosion hazard is slight. The soil blowing hazard is high. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, vineyards, and homesites.

The main limitation for irrigated orchards is the hazard of soil blowing.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Perennial cover crops

Figure 2.—Orchard on Burch loam, 3 to 8 percent slopes.

can reduce soil blowing. Cover crops also improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 4.5 inches of water should be applied every 16 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to homesites and septic tank absorption fields.

This soil is in capability subclass IIe, irrigated.

23—Cashmere fine sandy loam, 3 to 8 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium mixed with loess. Individual areas of this soil are somewhat oblong to irregular in shape and range in size from 2 to about 200 acres. Native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,500 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 190 days.

Typically, the surface layer is brown fine sandy loam about 11 inches thick. The subsoil is pale brown fine sandy loam about 13 inches thick. The substratum is pale brown fine sandy loam to a depth of 60 inches or more. Some pedons are up to 10 percent pebbles.

Included with this soil in mapping are small areas of Burch, Magallon, and Quincy soils and small areas that

have a loamy fine sand surface layer. Some soils have boulders on the surface and in the profile. Some small areas have a fine gravel substratum at a depth of 48 to 60 inches, and some soils have slopes of 0 to 3 percent.

Permeability of this Cashmere soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is slight. The soil blowing hazard is high. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay and pasture, vineyards, and homesites.

The main limitations of this soil for most uses is the hazard of soil blowing and slope.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Perennial cover crops can reduce soil blowing. Cover crops also improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 4.5 inches of water should be applied every 16 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. If furrow irrigation methods are used, the furrows should be on the contour, or across the slope.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to homesites and septic tank absorption fields.

This soil is in capability subclass IIIe, irrigated.

24—Cashmere fine sandy loam, 8 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium mixed with loess. Individual areas of this soil are somewhat oblong in shape and range in size from 2 to about 45 acres. The native vegetation is mainly grasses and shrubs. Elevation is 650 to 1,500 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 190 days.

Typically, the surface layer is brown fine sandy loam about 11 inches thick. The subsoil is pale brown fine sandy loam about 13 inches thick, and the substratum is pale brown fine sandy loam to a depth of 60 inches or more. Some pedons are up to 10 percent pebbles.

Included with this unit in mapping are small areas of Burch, Magallon, and Quincy soils and small areas that have slightly steeper slopes. Some soils have boulders on the surface and in the profile. Some small areas have a fine gravel substratum at a depth of 48 to 60 inches. Some areas have slopes of 15 to 25 percent.

Permeability of this Cashmere soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate. The soil blowing hazard is high. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay and pasture, vineyards, and homesites.

The main limitation for irrigated cropland is the soil blowing hazard and slope.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Perennial cover crops can reduce water erosion and soil blowing. Cover crops also improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 4.5 inches of water should be applied every 16 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Sprinklers are the most suitable method of applying water. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

The main limitation for homesites is slope. The steepness of slope is a concern in installing septic tank absorption fields. Absorption lines should be on the contour.

This soil is in capability subclass IVe, irrigated.

25—Cashmont sandy loam, 3 to 8 percent slopes. This very deep, well drained soil is mainly on fans and terraces. It formed in alluvium mixed with loess. Individual areas of this soil are irregular in shape and range in size from 3 to 60 acres. Native vegetation is grasses and shrubs. Elevation is 700 to 1,800 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 178 days.

Typically, the surface layer is dark gray sandy loam about 21 inches thick. The subsoil is brown gravelly sandy loam about 7 inches thick. The substratum is pale brown gravelly sandy loam to a depth of 60 inches or more. The surface layer is thinner on soils that have not been irrigated.

Included with this unit are small areas of Cashmere, Pogue, and Quincy soils. Also included are small areas that have a gravelly sandy loam and loam surface layer and small areas that have slopes of 0 to 3 percent.

Permeability of this Cashmont soils is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is slight. The soil

blowing hazard is high. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are also used for irrigated hay, pasture, and homesites.

The main limitations for irrigated orchards are the hazard of soil blowing, slope, and soil droughtiness.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Perennial cover crops can reduce soil blowing. Cover crops also improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 4.3 inches of water should be applied every 15 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. If furrow irrigation methods are used, the furrows should be on the contour, or across the slope.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

This soil is well suited to homesites and septic tank absorption fields.

This soil is in capability subclass IIIe, irrigated.

26—Cashmont gravelly sandy loam, 3 to 8 percent slopes. This very deep, well drained soil is mainly on fans and terraces. It formed in alluvium mixed with loess. Individual areas of this soil are irregular in shape and range in size from 2 to about 60 acres. Native vegetation is grasses and shrubs. Elevation is 700 to 1,800 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 178 days.

Typically, the surface layer is dark gray gravelly sandy loam about 21 inches thick. The subsoil is brown gravelly sandy loam about 7 inches thick. The substratum is pale brown gravelly sandy loam to a depth of 60 inches or more. The surface layer is thinner on soils that have not been irrigated.

Included with this unit are small areas of Cashmere, Pogue, and Quincy soils. Also included are small areas that have a gravelly loam, sandy loam, or cobbly sandy loam surface layer.

Permeability of this Cashmont soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is slight. There is a moderate soil blowing hazard. The surface layer is very friable and easily tilled.

This unit is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

The main limitations for irrigated orchards are the soil droughtiness and slope.

Cover crops improve fertility, reduce crusting, and increase water infiltration. Care is needed when cutting the cover crops or mowing hay because the gravel on the surface can damage equipment.

At the peak of the growing season, about 3.7 inches of water should be applied every 14 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. If furrow irrigation methods are used, the furrows should be on the contour, or across the slope.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, and weed control can help keep the pasture and soil in good condition.

This soil is well suited to homesites and septic tank absorption fields.

This soil is in capability subclass IIIe, irrigated.

27—Cashmont gravelly sandy loam, 8 to 15 percent slopes. This very deep, well drained soil is mostly on fans and terraces. It formed in alluvium mixed with loess. Individual areas of this unit are somewhat oblong in shape and range in size from 2 to about 70 acres. Native vegetation is grasses and shrubs. Elevation is 700 to 1,800 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 178 days.

Typically, the surface layer is dark gray gravelly sandy loam about 21 inches thick. The subsoil is brown gravelly sandy loam about 7 inches thick, and the substratum is pale brown gravelly sandy loam to a depth of 60 inches or more. The surface layer is thinner in areas that have not been irrigated.

Included with this soil in mapping are small areas that have a sandy loam, gravelly loam, or cobbly sandy loam surface layer. Also included are small areas that have slopes of 15 to 25 percent.

Permeability of this Cashmont soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate. There is a moderate soil blowing hazard. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

The main limitations for irrigated orchards are the slope and soil droughtiness.

Cover crops improve fertility, reduce crusting, and increase water infiltration. Care is needed when cutting the cover crop or mowing hay because the gravel on the surface can damage equipment.

At the peak of the growing season, about 3.7 inches of water should be applied every 14 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Sprinklers are the most suitable method of applying water. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizers, and weed control help keep the pasture and soil in good condition.

Slope is the main limitation for homesites and septic tank absorption fields.

This soil is in capability subclass IVe, irrigated.

28—Cashmont cobbly sandy loam, 3 to 15 percent slopes. This very deep, well drained soil is mostly on the upper part of fans on terraces. It formed in alluvium mixed with loess. Individual areas of this unit are mostly irregular in shape and range in size from 2 to about 30 acres. Native vegetation is grasses and shrubs. Elevation is 700 to 1,800 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 178 days.

Typically, the surface layer is dark gray cobbly sandy loam about 21 inches thick. The subsoil is brown gravelly sandy loam about 7 inches thick, and the substratum is pale brown gravelly sandy loam to a depth of 60 inches or more. The surface layer is thinner in areas that have not been irrigated.

Included with this soil in mapping are small areas that have a gravelly sandy loam, cobbly loam, or stony sandy loam surface layer. Also included are some soils that have slopes of 15 to 25 percent.

Permeability of this Cashmont soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate. There is a moderate soil blowing hazard. The surface layer is very friable, but the cobble and gravel in the surface layer may cause difficulty in tilling.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay and pasture.

The main limitations for irrigated orchards are the slope and soil droughtiness.

Cover crops improve fertility, reduce crusting, and increase water infiltration. Care is needed when cutting the cover crops or mowing hay because the gravel on the surface can damage equipment.

At the peak of the growing season, about 3.7 inches of water should be applied every 13 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Sprinklers are the most suitable method of applying water. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

This soil is in capability subclass IVe, irrigated.

29—Cashmont Variant, fine sandy loam, 3 to 8 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium mixed with loess in the surface layer. Individual areas of this soil are somewhat irregular in shape and range in size from 10 to about 300 acres. Native vegetation is grasses and shrubs. Elevation is 800 to 1,200 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 178 days.

Typically, the surface layer is brown fine sandy loam about 12 inches thick, and the subsoil is pale brown loam about 8 inches thick. The substratum is light yellowish brown very gravelly loam and very pale brown extremely gravelly loam to a depth of 60 inches or more. The depth to the substratum ranges from 17 to 25 inches.

Included with this soil in mapping are small areas of Burch, Cashmere, and Magallon soils.

Permeability of this Cashmont Variant soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is slight. There is a high hazard of soil blowing. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

The main limitations for irrigated orchards are the slope and high hazard of soil blowing.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Perennial cover crops can reduce soil blowing. Cover crops also improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 3.0 inches of water should be applied every 10 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. If furrow irrigation methods are used, the furrows should be on the contour, or across the slope. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings,

fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

This soil is well suited to homesites.

The main limitation for septic tank absorption fields is the moderately slow permeability in the substratum.

This soil is in capability subclass IIIe, irrigated.

30—Cashmont Variant, fine sandy loam, 8 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium mixed with loess in the surface layer. Individual areas of this soil are irregular in shape and range in size from 4 to about 40 acres. Native vegetation is grasses and shrubs. Elevation is 800 to 1,200 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 178 days.

Typically, the surface layer is brown fine sandy loam about 12 inches thick, and the subsoil is pale brown loam about 8 inches thick. The substratum is light yellowish brown very gravelly loam and very pale brown extremely gravelly loam to a depth of 60 inches or more. Depth to the substratum ranges from 17 to 25 inches.

Included with this soil in mapping are small areas of Burch, Cashmere, and Magallon soils and small areas that have a gravelly fine sandy loam surface layer. Also included are small areas that have slopes of 15 to 25 percent.

Permeability of this Cashmont Variant soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate. There is a high hazard of soil blowing. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

The main limitations for irrigated orchards are the slope and hazard of soil blowing.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Perennial cover crops can reduce water erosion and soil blowing. Cover crops improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 3.0 inches of water should be applied every 10 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Sprinklers are the most suitable method of irrigation. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

The main limitation for homesites is slope. The main limitation for septic tank absorption fields is the moderately slow permeability in the substratum.

This soil is in capability subclass IVe, irrigated.

31—Chelan very fine sandy loam, gravelly substratum, 0 to 8 percent slopes. This very deep, well drained soil is on high terraces. It formed in loess, volcanic ash, and pumice over glacial outwash. Individual areas of this soil are somewhat oblong in shape and range in size from 3 to 100 acres. Native vegetation is grasses and shrubs. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 180 to 200 days.

Typically, the surface layer is light brownish gray very fine sandy loam about 9 inches thick. The subsoil is yellowish brown very fine sandy loam about 13 inches thick. The upper part of the substratum is light yellowish brown very fine sandy loam about 28 inches thick, and the lower part is extremely cobbly sand to a depth of 60 inches or more. Depth to the cobbly sand is 48 to 60 inches.

Included with this soil in mapping are small areas of Supplee soil.

Permeability of this Chelan soil is moderate to a depth of about 50 inches and very rapid below that. Available water capacity is high. Effective rooting depth is 60 inches or more. There is a high hazard of soil blowing. Surface runoff is slow, and the water erosion hazard is moderate.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are grown. Some areas are used for irrigated hay, pasture, nonirrigated cropland, and homesites.

The main limitations for croplands are the slope, hazard of soil blowing, and water erosion.

Cover crops in orchards can reduce water erosion and soil blowing. Cover crops also improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 6.0 inches of water should be applied every 18 days at a rate of 0.6 inch per hour for sprinkler irrigation of mature orchards. Care should be taken not to apply water too fast because these soils erode easily. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

Erosion can be reduced on nonirrigated cropland if stubble mulch tillage is used, waterways are shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and winter wheat is seeded early.

This soil is well suited to homesites, but it is a poor filter for septic tank absorption fields.

This soil is in capability subclass IIIe, irrigated, and IIIe, nonirrigated.

32—Chelan association, bouldery. This unit is on terraces and terrace side slopes. It formed in loess, volcanic ash, and pumice overlying glacial drift. Slope is 3 to 65 percent. Native vegetation is mainly bunchgrass and sagebrush. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is 50 degrees F, and the frost-free season is 150 to 190 days.

This unit is about 50 percent Chelan bouldery very fine sandy loam, 3 to 30 percent slopes, and 30 percent Chelan bouldery very fine sandy loam, 30 to 65 percent slopes. The Chelan bouldery very fine sandy loam, 3 to 30 percent slopes, occurs on terraces. The Chelan bouldery very fine sandy loam, 30 to 65 percent slopes, occurs on the terrace side slopes.

Included with this unit in mapping are areas of Bakeoven, Entiat, Supplee, and the nonbouldery Chelan soils.

These soils are very deep and well drained. Typically, the surface layer of the Chelan soil is light brownish gray bouldery very fine sandy loam about 10 inches thick. The subsoil is light brownish gray very fine sandy loam about 15 inches thick. The upper part of the substratum is yellowish brown very fine sandy loam about 21 inches thick, and the lower part is light gray very cobbly sandy loam to a depth of 60 inches or more.

Permeability of the Chelan soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. The Chelan soil with 3 to 30 percent slopes has slow surface runoff and a moderate hazard of water erosion. The Chelan soil with 30 to 65 percent slopes has rapid surface runoff and a high hazard of water erosion.

This unit is used mainly for rangeland and wildlife.

Potential native vegetation consists mainly of bluebunch wheatgrass, needleandthread, Sandberg bluegrass, rabbitbrush, and big sagebrush. Management of the vegetation should be designed to increase production of bluebunch wheatgrass and needleandthread on this unit.

On Chelan bouldery very fine sandy loam, 3 to 30 percent slopes, mechanical brush management and seeding is practical, but some difficulty will be encountered because of the bouldery surface. For best results, the seedbed should be properly prepared and a grass drill used. The plants selected for seeding should be adapted species.

On Chelan bouldery very fine sandy loam, 35 to 65 percent slopes, brush management by aerial spraying can improve deteriorated range. Slope is the main limitation for mechanical treatment or seeding.

Management practices suitable for this unit are proper grazing, deferred grazing, and rotation grazing, along with needed water development.

The Chelan bouldery very fine sandy loam, 3 to 30 percent slopes, is in capability subclass VIe, nonirrigated. The Chelan bouldery very fine sandy loam, 30 to 65 percent slopes, is in capability subclass VIIe, nonirrigated.

33—Chelan association, steep. This unit is on terraces and terrace side slopes. It formed in loess, volcanic ash, and pumice. Slope is 3 to 65 percent. Native vegetation is bunchgrass and sagebrush. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 145 to 180 days.

This unit is about 55 percent Chelan loam, 30 to 65 percent slopes, and 30 percent Chelan loam, 3 to 30 percent slopes. The Chelan loam, 30 to 65 percent slopes, is on the terrace side slopes. Chelan loam, 3 to 30 percent slopes, is on terraces.

Included with this unit in mapping are areas of Dougville, Ralls, and Quincy soils; some small areas of soils with bedrock at a depth of 40 to 60 inches; and some areas of granite outcrops. These included areas make up as much as 15 percent of the unit.

These Chelan soils are very deep and well drained. Typically, the surface layer is light brownish gray loam about 10 inches thick. The subsoil is light brownish gray very fine sandy loam about 15 inches thick. The upper part of the substratum is yellowish brown very fine sandy loam about 21 inches thick, and the lower part is light gray very cobbly sandy loam to a depth of 60 inches or more.

Permeability of these Chelan soils is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. The Chelan soil with 30 to 65 percent slopes has rapid surface runoff and a high hazard of water erosion. The Chelan soil with 3 to 30 percent slopes has medium surface runoff and a moderate hazard of water erosion.

This unit is used mainly for rangeland, nonirrigated cropland, and wildlife habitat.

The Chelan loam, 30 to 65 percent slopes, is used mainly for rangeland. The potential native vegetation is bluebunch wheatgrass, needleandthread, big sagebrush, and Sandberg bluegrass.

Management of the vegetation for livestock grazing on this unit should be designed to increase production of bluebunch wheatgrass and needleandthread. Brush management by aerial spraying and proper grazing can improve deteriorated range. Mechanical brush management is generally not practical because of the slope. Management practices suitable for this unit are proper grazing, deferred grazing, and rotation grazing, along with needed water development.

The Chelan loam, 3 to 30 percent slopes, is used mainly for nonirrigated cropland. Winter wheat in a summer-fallow system is the main crop. Erosion can be reduced if stubble mulch tillage is used, waterways are

shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and tillage is on the contour. Terraces, diversions, and stripcropping, used singly or in combination, can also reduce erosion.

The Chelan loam, 30 to 65 percent slopes, is in capability subclass VIIe, nonirrigated. The Chelan loam, 3 to 30 percent slopes, is in capability subclass VIe, nonirrigated.

34—Condon-Rock Creek-Broadax association, strongly sloping. This unit is on side slopes and tops of broad ridges on the basalt plateaus. It formed in loess and residuum from basalt. Slope is 0 to 15 percent. Native vegetation is mainly grass and sagebrush. Elevation is 2,400 to 4,000 feet. The average annual precipitation is 12 to 15 inches, mean annual air temperature is about 47 degrees F, and the frost-free season is 110 to 150 days.

This unit is about 35 percent Condon silt loam, 0 to 15 percent slopes; 30 percent Rock Creek very cobbly silt loam, 0 to 15 percent slopes; and 25 percent Broadax silt loam, 0 to 15 percent slopes. The Condon soil is in biscuitlike mounds and long narrow stringers. Rock Creek is next to the mounds and on lower areas of the unit. Broadax soils occur mostly on the ridges or highest part of the unit.

Included with this unit in mapping are small areas of Badge, Bakeoven, and Zen soils. These included areas make up about 10 percent of the unit.

The Condon soil is moderately deep and well drained. It formed in loess. Typically, it has a grayish brown, silt loam surface layer about 7 inches thick. The subsoil is brown and pale brown silt loam about 27 inches thick over basalt at a depth of about 34 inches. Depth to the basalt ranges from 20 to 40 inches.

Permeability of this Condon soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the hazard of water erosion is slight.

The Rock Creek soil is shallow and well drained. It formed in residuum from basalt mixed with loess. Typically, it has a brown, very cobbly silt loam surface layer about 3 inches thick. The subsoil is brown and dark brown very gravelly clay loam, very gravelly clay, and extremely cobbly clay about 9 inches thick over basalt at a depth of about 12 inches. Depth to the basalt ranges from 8 to 20 inches.

Permeability of this Rock Creek soil is moderately slow. Available water capacity is low. Effective rooting depth is 8 to 20 inches. Surface runoff is medium, and the hazard of water erosion is moderate.

The Broadax soil is very deep and well drained. It formed in loess. Typically, it has a grayish brown, silt loam surface layer about 13 inches thick. The subsoil is pale brown silty clay loam and yellowish brown heavy silt loam about 22 inches thick. The substratum is pale brown silt loam to a depth of 60 inches or more.

Permeability of this Broadax soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate.

This unit is used mainly for rangeland and wildlife habitat.

The Condon and Broadax soils have a potential native vegetation of bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and threetip sagebrush. The potential native vegetation on Rock Creek soil is Sandberg bluegrass, bluebunch wheatgrass, stiff sagebrush, and Eriogonum.

Management of vegetation on the Condon and Broadax soils should be designed to increase production of bluebunch wheatgrass and Idaho fescue. Brush management and proper grazing can improve deteriorated range. If the range vegetation is seriously deteriorated, seeding is needed. The plants selected for seeding should be adapted species. For best results, the seedbed should be properly prepared and a grass drill used. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand the expected intensity of grazing.

Management of vegetation on the Rock Creek soil should be designed to maintain production of Sandberg bluegrass and increase the production of bluebunch wheatgrass. Mechanical brush management is generally not practical because of the cobbles and stones on the surface. Management practices suitable for this soil are proper grazing, deferred grazing, rotation grazing, and aerial spraying for brush management and water development.

The Condon soil is in capability subclass IIIe, nonirrigated; the Rock Creek soil is in VIIs, nonirrigated; and the Broadax soil is in IIIe, nonirrigated.

35—Cordy association, steep. This unit is on north-facing mountain slopes. It formed in loess mixed with volcanic ash. Slope is 3 to 55 percent. Native vegetation is mainly conifers. Elevation is 3,000 to 4,200 feet. The average annual precipitation is 12 to 15 inches, mean annual air temperature is about 44 degrees F, and the frost-free season is 90 to 120 days.

This unit is about 40 percent Cordy loam, 3 to 30 percent slopes, and about 40 percent Cordy loam, 30 to 55 percent slopes. The Cordy loam, 3 to 30 percent slopes, occurs in the middle of the mountain slopes. The Cordy loam, 30 to 55 percent slopes, occurs on slopes breaking into the drainageways.

Included with this unit in mapping are areas of Badge, Condon, and Rock Creek soils. These included areas make up about 10 percent of the total acreage.

The Cordy soils are very deep and well drained. Typically, the surface layer is brown loam about 12 inches thick. The subsoil is yellowish brown loam and brown silt loam 28 inches thick. The substratum is yellowish brown silt loam to a depth of 60 inches or more.

Permeability of these Cordy soils is moderate. Available water capacity is high. Effective rooting depth

is 60 inches or more. The Cordy soil with 3 to 30 percent slopes has medium surface runoff and a moderate hazard of water erosion. The Cordy soil with 30 to 55 percent slopes has rapid surface runoff and a high hazard of water erosion.

This unit is used for grazable woodland and wildlife habitat.

Douglas-fir and ponderosa pine are the main trees on this unit. On the basis of a 100-year site curve, the mean site index is 90 for Douglas-fir and ponderosa pine. The culmination of the mean annual increment (CMAI) for Douglas-fir and ponderosa pine is 85 cubic feet per acre for fully stocked, unmanaged stands.

The main limitation for the harvesting of timber on this unit is an equipment limitation caused by the slope on the Cordy loam, 30 to 55 percent slopes. The volcanic ash in the surface layer may make the logging roads dusty during dry summer months.

The native understory vegetation is mainly pinegrass, bluebunch wheatgrass, balsamroot, and lupine and minor amounts of serviceberry, snowberry, rose, meadowrue, and yarrow. The understory production is about 750 to 900 pounds per acre per year under normal conditions. As crown density increases the amount of understory vegetation decreases.

Managing brush by proper grazing management is the best way of improving deteriorated grazing areas. Aerial spraying and mechanical brush management is generally not practical because of the steep slopes and dense stands of trees.

The Cordy loam, 3 to 30 percent slopes, is in capability subclass IVe, nonirrigated. The Cordy loam, 30 to 55 percent slopes, is in capability subclass VIIe, nonirrigated.

36—Cordy-Rock Creek association, steep. This unit is on mountain slopes, side slopes, and ridgetops. It formed in loess, volcanic ash, and weathered basalt. Slope is 3 to 30 percent. Elevation is 3,000 to 4,200 feet. Native vegetation is mainly grass and brush with scattered trees. The average annual precipitation is 12 to 15 inches, mean annual air temperature is about 45 degrees F, and the frost-free season is 90 to 150 days.

This unit is about 50 percent Cordy loam, 3 to 30 percent slopes, and 30 percent Rock Creek very cobbly silt loam, 3 to 30 percent slopes. The Cordy soil is on ridgetops as biscuitlike mounds or as long narrow stringers and on short, north-facing slopes. The Rock Creek soil is interspersed between the mounds.

Included with this unit in mapping are areas of Condon and Dinkels soils and small areas of Rock outcrop. These included areas make up 20 percent of the unit.

The Cordy soil is very deep and well drained. It formed in loess mixed with volcanic ash. Typically, it has a brown loam surface layer 12 inches thick. The subsoil is yellowish brown loam and brown silt loam 28 inches thick. The substratum is yellowish brown silt loam to a depth of 60 inches or more.

Permeability of this Cordy soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is rapid, and the hazard of water erosion is high.

The Rock Creek soil is shallow and well drained. It formed in residuum from basalt mixed with loess. Typically, the surface layer is brown very cobbly silt loam 3 inches thick. The subsoil is brown and dark brown very gravelly clay loam, very gravelly clay, and extremely cobbly clay about 9 inches thick over basalt at a depth of about 12 inches. Depth to the basalt ranges from 8 to 20 inches.

Permeability of the Rock Creek soil is moderately slow. Available water capacity is low. Effective rooting depth is 8 to 20 inches. Surface runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly for grazable woodland, rangeland, and wildlife habitat.

The Cordy soil is used for woodland. Ponderosa pine is the main tree. On the basis of a 100-year site curve, the mean site index is 90. The culmination of the mean annual increment (CMAI) for ponderosa pine is 85 cubic feet per acre for fully stocked unmanaged stands.

The understory vegetation on the Cordy soil consists mainly of bluebunch wheatgrass, balsamroot, bitterbrush, and serviceberry. The understory production is about 750 to 900 pounds per acre per year under normal conditions. As crown density increases, the amount of understory decreases. Management of the vegetation on the Cordy soil should be designed to increase production of bluebunch wheatgrass where the trees have been cleared. Brush management and proper grazing can improve deteriorated range. Seeding is suitable if the vegetation is in poor condition. The plants selected for seeding should be adapted species. For best results, the seedbed should be prepared and a grass drill used.

The main limitations of Rock Creek soil for rangeland are the shallow rooting depth and surface cobbles. Potential native vegetation on the Rock Creek soil is bluebunch wheatgrass, Sandberg bluegrass, Erigonum, stiff sagebrush, and scattered ponderosa pine. Management of the vegetation should be designed to increase production of bluebunch wheatgrass and maintain Sandberg bluegrass. Proper grazing management can improve deteriorated range. Mechanical brush management is not practical because of the very cobbly surface layer. Other practices suitable for this soil are deferred grazing and rotation grazing.

The Cordy soil is in capability subclass IVe, nonirrigated. The Rock Creek soil is in capability subclass VIIs, nonirrigated.

37—Dinkels gravelly loam, 25 to 70 percent slopes. This very deep, well drained soil is on side slopes of the upland plateau and on low mountain slopes. It formed in colluvium mixed with loess and volcanic ash. Native vegetation is mainly grass with scattered conifers. Elevation is 800 to 3,200 feet. The average annual

precipitation is 12 to 15 inches, mean annual air temperature is about 46 degrees F, and the frost-free season is 90 to 140 days.

Typically, the surface layer is grayish brown and brown gravelly loam about 13 inches thick. The upper part of the subsoil is pale brown gravelly sandy loam about 11 inches thick, and the lower part is pale brown very gravelly coarse sandy loam about 19 inches thick. Granite is at a depth of 43 inches. Depth to the bedrock ranges from 40 to 60 inches.

Included with this soil in mapping are areas of Badge, Chelan, Condon, Cordy, Entiat, Ralls, and Rock Creek soils and some small areas of granite outcrops. These included areas make up 20 percent of the unit. Also included are areas of soils similar to Dinkels but which are 35 to 60 percent coarse fragments in the subsoil and are deeper than 60 inches over bedrock. These areas make up another 20 percent of the unit.

Permeability of this Dinkels soil is moderate. Available water capacity is moderate. Effective rooting depth is 40 to 60 inches. Surface runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly for rangeland and wildlife habitat.

Slope is the main limitation for rangeland.

The potential native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue, and bitterbrush with scattered Douglas-fir and ponderosa pine. Where the crown density is greatest, the amount of understory vegetation is less.

Management of the vegetation should be designed to increase production of bluebunch wheatgrass and Idaho fescue. Mechanical brush management is generally not practical because of steep slopes, stones, and scattered trees. Management practices suitable for this soil are proper grazing use, deferred grazing, rotation grazing, aerial spraying for brush management, and water development.

This soil is in capability subclass VIIe, nonirrigated.

38—Dougville loam, 0 to 15 percent slopes. This very deep, well drained soil is on basalt plateaus. It formed in loess mixed with volcanic ash and cinders. Native vegetation is mainly bunchgrass and sagebrush. Elevation is 2,400 to 3,200 feet. The average annual precipitation is 10 to 12 inches, mean annual air temperature is about 49 degrees F, and the frost- free season is 140 to 180 days.

Typically, the surface layer is grayish brown loam about 9 inches thick. The subsoil is brown loam 15 inches thick. The upper part of the substratum is brown loam 18 inches thick, and the lower part is light yellowish brown heavy silt loam to a depth of 60 inches or more.

Included with this soil in mapping are areas of Condon soils that make up 10 percent of the unit. Areas of Dougville soils with short slopes of 15 to 30 percent make up about 5 percent of the unit. Also included are areas of Renslow and Willis soils that make up 10 percent of the unit. Basalt may be within 40 inches of the surface in some areas of the Dougville soil.

Permeability of this Dougville soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate.

The soil is used mainly for nonirrigated cropland and wildlife habitat. A few areas are used for rangeland.

The main crop is winter wheat in a summer-fallow system. Precipitation is generally too low to support annual cropping. Erosion can be reduced on nonirrigated cropland if stubble mulch tillage is used, waterways are shaped and seeded to perennial grass, stable fields are chiseled in the fall, and winter wheat is seeded early.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. Management of the vegetation should be designed to increase production of bluebunch wheatgrass and Idaho fescue. Brush management by mechanical means, spraying, and proper grazing management; deferred grazing; and rotation grazing can improve deteriorated range. If the range vegetation is seriously deteriorated, seeding is needed. The plants selected for seeding should be adapted species. A proper seedbed should be prepared, and seeding done with a drill.

This soil is in capability subclass IIIe, nonirrigated.

39—Ellisforde fine sandy loam, 3 to 8 percent slopes. This very deep, well drained soil is on terraces. It formed in loess overlying lake sediment. Individual areas of this unit are irregular in shape and range in size from 5 to about 70 acres. Native vegetation is mainly bunchgrass and sagebrush. Elevation is 700 to 2,100 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 160 to 180 days.

Typically, the surface layer is brown fine sandy loam about 12 inches thick. The subsoil is pale brown very fine sandy loam about 15 inches thick. The substratum is light gray stratified silt loam and very fine sandy loam to a depth of 60 inches or more. Depth to lime ranges from 24 to 30 inches.

Included with this soil in mapping are small areas of Burch and Magallon soils and small areas that have a loam or very fine sandy loam surface layer.

Permeability of this Ellisforde soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is slight. The surface layer is very friable and easily tilled. There is a high hazard of soil blowing.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. A few areas are also used for irrigated hay, pasture, or homesites. The main limitations for irrigated orchards are the slope, hazard of soil blowing, and hazard of water erosion.

Cover crops in orchards can reduce water and soil blowing. Cover crops also improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 5.0 inches of water should be applied every 18 days at a rate of 0.25 inch per hour for sprinkler irrigation of mature orchards. The application rate should be reduced if runoff results. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking rates, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, and weed control can help keep the pasture and soil in good condition.

This soil is well suited to homesites.

Moderately slow permeability in the substratum is the main limitation for septic tank absorption fields.

This soil is in capability subclass IIIe, irrigated.

40—Ellisforde loam, 0 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in loess overlying lake sediment. Native vegetation is mainly grasses and shrubs. Elevation is 700 to 2,100 feet. The average annual precipitation is 9 to 10 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 140 to 180 days.

Typically, the surface layer is brown loam about 12 inches thick. The subsoil is pale brown silt loam about 15 inches thick. The substratum is light gray, calcareous, stratified silt loam and very fine sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are areas of Ellisforde loam with slopes of more than 15 percent that make up about 20 percent of the unit. Also included are areas of Touhey and Umapine Variant soils and some areas of Aquolls, nearly level, and Haploxerolls, gently sloping, that make up 15 percent of the unit.

Permeability of this Ellisforde soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is moderate.

This soil is used mainly for nonirrigated cropland and wildlife habitat. A small acreage is rangeland.

The main crop is winter wheat in a summer-fallow system. Precipitation is generally too low for annual cropping. Erosion can be reduced on nonirrigated cropland if stubble mulch tillage is used, waterways are shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and winter wheat is seeded early.

The potential native vegetation is bluebunch wheatgrass, Sandberg bluegrass and big bluegrass.

Management of the vegetation should be designed to increase production of bluebunch wheatgrass, and big bluegrass. Brush management by mechanical means; spraying; and proper grazing, deferred grazing, or rotation grazing can improve deteriorated range. Seeding is needed if the range vegetation is seriously deteriorated. The plants selected for seeding should be adapted species. A proper seedbed should be prepared and seeding done with a drill.

This soil is in capability subclass IIIe, nonirrigated.

41—Ellisforde association, steep. This unit is on terraces and terrace escarpments. The soils formed in loess overlying lake sediment. Slope is 15 to 60 percent. Native vegetation is mainly grass and shrubs. Elevation is 700 to 2,100 feet. The average annual precipitation is 9 to 10 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 140 to 180 days.

This unit is about 45 percent Ellisforde loam, 15 to 30 percent slopes, and 40 percent Ellisforde loam, 30 to 60 percent slopes. The Ellisforde loam, 15 to 30 percent slopes, occurs on the terraces. The Ellisforde loam, 30 to 60 percent slopes, occurs on the terrace escarpments.

Included with this unit in mapping are areas of Heytou, Touhey, and Umapine Variant soils and some small areas of Rock outcrop. These included areas make up about 15 percent of the unit.

Typically, Ellisforde soils are very deep and well drained. They have a brown loam surface layer about 12 inches thick. The subsoil is pale brown silt loam about 15 inches thick. The substratum is light gray, calcareous, stratified silt loam and very fine sandy loam to a depth of 60 inches or more.

Permeability of these Ellisforde soils is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. The Ellisforde loam, 15 to 30 percent slopes, has medium runoff, and the water erosion hazard is moderate. The Ellisforde loam, 30 to 60 percent slopes, has very rapid runoff, and the water erosion hazard is very high.

This unit is used mainly for rangeland and wildlife habitat. The Ellisforde loam, 15 to 30 percent slopes, may also be used for nonirrigated cropland.

The potential native vegetation on this unit is bluebunch wheatgrass, Sandberg bluegrass, big bluegrass, and big sagebrush.

Management of the vegetation on this soil should be designed to increase production of bluebunch wheatgrass. On the Ellisforde loam, 3 to 30 percent slopes, brush management by aerial spraying, mechanical means, and proper grazing can improve deteriorated range. The plants selected for seeding should be adapted species. For best results, seedbeds should be properly prepared and seeding done with a drill. On the Ellisforde loam, 30 to 60 percent slopes, brush management by aerial spraying, proper grazing, and deferred or rotation grazing can improve deteriorated range. Mechanical brush management and seeding is not practical because of the steep slopes.

Where the Ellisforde loam, 15 to 30 percent slopes, is used for nonirrigated cropland, the main crop is winter wheat in a summer-fallow system. Precipitation is

generally too low to support annual cropping. Erosion can be reduced on nonirrigated cropland if stubble mulch tillage is used, waterways are shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and winter wheat is seeded early.

The Ellisforde loam, 15 to 30 percent slopes, is in capability subclass IVe, nonirrigated. The Ellisforde loam, 30 to 60 percent slopes is in capability subclass VIIe, nonirrigated.

42—Entiat-Rock outcrop complex, steep. This unit is on upland side slopes. The soils formed in material weathered from granitic bedrock mixed with loess. Slope is 25 to 70 percent. Native vegetation is mainly grass and sagebrush. Elevation is 800 to 2,500 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 140 to 180 days.

This unit is about 55 percent Entiat gravelly fine sandy loam, 25 to 70 percent slopes, and 25 percent Rock outcrop. The Entiat soil is on the major portion of south-facing hillsides. Rock outcrop occurs on the higher convex areas.

Included with this soil in mapping are areas of Badge, Chelan, and Dinkels soils. These areas make up as much as 20 percent of the unit.

Typically, the Entiat soil is shallow and well drained. It has a brown, gravelly fine sandy loam surface layer about 6 inches thick. The subsoil is yellowish brown very gravelly loam about 5 inches thick. The substratum is light yellowish brown very gravelly loam about 6 inches thick. Partially weathered granodiorite is at a depth of about 17 inches. Depth to the granodiorite ranges from 12 to 20 inches.

Permeability of this Entiat soil is moderately rapid. Available water capacity is low. Effective rooting depth is 12 to 20 inches. Surface runoff is rapid, and the water erosion hazard is high.

The Rock outcrop part of this unit consists of exposed areas of granodiorite bedrock.

This unit is used mainly for rangeland and wildlife habitat.

The main limitations of this unit for rangeland are the slopes and rock outcrops.

Potential native vegetation is bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, arrowleaf balsamroot, and bitterbrush. Management of the vegetation should be designed to increase production of the bluebunch wheatgrass. Brush management by mechanical methods is generally not practical because of the steep slopes and rock outcrops. Management practices suitable for this unit are proper grazing, deferred grazing, rotation grazing, aerial spraying for brush management, and water development.

This soil is in capability subclass VIIs, nonirrigated.

43—Esquatzel loam. This very deep, well drained soil is on low terraces and bottom lands. It formed in alluvium. Slope is 0 to 2 percent. Native vegetation is bunchgrass and rabbitbrush. Elevation is 800 to 1,900 feet. The average annual precipitation is 7 to 10 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 140 to 210 days.

Typically, it has a brown, loam surface layer about 10 inches thick. The upper part of the underlying material is pale brown silt loam about 12 inches thick. The next layer is pale brown silt loam about 12 inches thick, and the lower part is light yellowish brown stratified silt loam to very fine sandy loam to 60 inches or more.

Included with this soil in mapping are areas of Finley, Kiona, Quincy, Strat, and Umapine Variant soils. These included areas make up 10 percent of the unit.

Permeability of this Esquatzel soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. The surface runoff is very slow, and the water erosion hazard is slight. This soil is subject to rare flooding in spring and during summer thunderstorms.

This soil is used for nonirrigated and irrigated cropland and wildlife habitat.

When this soil is used for nonirrigated cropland the main crop is winter wheat in a summer-fallow system. Precipitation is generally too low to support annual cropping. Stubble mulch tillage and grassed waterways can reduce erosion.

This soil is well suited to irrigated cropland. Crop residues can be used to maintain or improve the organic matter content and structure.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method of irrigation used is generally governed by the crop. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

This soil is in capability class I, irrigated, and subclass IIIc, nonirrigated.

44—Finley loam, 3 to 8 percent slopes. This very deep, well drained soil is on terraces along drainageways. It formed in alluvium mixed with loess in the surface layer. Native vegetation is mainly bunchgrass and brush. Elevation is 800 to 1,000 feet. The average annual precipitation is 7 to 9 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 140 to 210 days.

Typically, the surface layer is light yellowish brown loam about 6 inches thick. The subsoil is pale brown very gravelly loam about 16 inches thick. The upper part of the substratum is light gray extremely gravelly loam about 4 inches thick, and the lower part is multicolored extremely gravelly loamy sand to a depth of 60 inches or more.

Included with this soil in mapping are areas of Finley soils with slopes of more than 8 percent that make up as much as 15 percent of the unit. Also included are areas of Esquatzel and Kiona soils and small areas of Rubble land that make up 10 percent of the unit. There are also areas that are cobbly and stony on the surface.

Permeability of this Finley soil is moderately rapid to a depth of 26 inches and very rapid below that. Available water capacity is moderate. The effective rooting depth is 60 inches or more. The surface runoff is slow, and the hazard of water erosion is slight.

This soil is used mainly for rangeland and wildlife habitat.

The potential native vegetation is mainly needleandthread, bluebunch wheatgrass, Thurber needlegrass, and rabbitbrush.

Management of the vegetation should be designed to increase production of bluebunch wheatgrass and needleandthread. Brush management by mechanical or aerial spraying and proper grazing can improve deteriorated range. Range seeding is suitable if the range is in poor condition. The plants selected for seeding should be adapted species. The seedbed should be properly prepared and seeded with a range drill. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand the anticipated intensity of grazing.

This soil is in capability subclass VIe, nonirrigated.

45—Haploxerolls, nearly level. These deep, moderately well drained soils are on basalt plateaus. They formed in alluvium mixed with loess. Slope is 0 to 2 percent. Native vegetation is bunchgrass and sagebrush. Elevation is 2,500 to 3,000 feet. The average annual precipitation is 9 to 15 inches, mean annual air temperature is about 49 degrees F, and the frost-free season is 110 to 165 days. This unit is in nearly level, concave bottoms of depressions and potholes and in long narrow areas along streams and drainageways.

Included with this unit in mapping are areas of Broadax, Heytou, and Touhey soils and of Aquolls, nearly level, that make up as much as 15 percent of the unit. Also included are small areas that are moderately alkaline.

No one pedon represents this map unit but in one of the more common ones the surface layer is brown and pale brown loam about 16 inches thick. The subsoil is light olive gray heavy silt loam about 9 inches thick. The substratum is gray and light gray silt loam to a depth of 60 inches or more. Textures vary widely within short distances.

Permeability of these Haploxerolls is dominantly moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. The surface runoff is ponded to very slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 3.0 to 5.0 feet during March through April. This soil ponds in spring and during summer thunderstorms.

This unit is used mainly for nonirrigated cropland and wildlife habitat. Some areas are used for rangeland.

When this unit is used for nonirrigated cropland, the main crop is winter wheat in a summer-fallow system. Precipitation is generally too low to support annual cropping. Erosion can be reduced on nonirrigated cropland if stubble mulch tillage is used, waterways are shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and winter wheat is seeded early.

When this unit is used for rangeland, the vegetation should be managed to increase the production of the grasses. Brush management by aerial spraying or mechanical means and proper grazing can improve deteriorated range. If the range vegetation is seriously deteriorated, seeding is needed. The plants selected for seeding should be adapted species. For best results, the seedbed should be properly prepared and a grass drill used. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand the anticipated intensity of grazing.

This unit is in capability subclass IVw, nonirrigated.

46—Haploxerolls, gently sloping. These deep, well drained soils are on terraces, fans, and terrace side slopes. They formed in glacial outwash and alluvium mixed with loess in the surface. Native vegetation is mainly bunchgrass and sagebrush. Slope is 3 to 15 percent. Elevation is 600 to 1,600 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 165 to 190 days.

Included with this unit in mapping are areas of Quincy soils that make up 10 percent of the unit. Also included are small areas of Beverly, Burbank, Chelan, Malaga, Pogue, and Supplee soils and small areas of Xerofluvents, nearly level, and Xerorthents, very steep, that make up 30 percent of the unit.

No one pedon represents this map unit but in one of the more common ones the surface layer is grayish brown fine sandy loam about 16 inches thick. The subsoil is brown cobbly fine sandy loam about 18 inches thick. The upper part of the substratum is yellowish brown extremely gravelly sandy loam about 7 inches thick, and the lower part is sand, gravel, cobble, and stones to a depth of 60 inches or more. These soils are underlain by gravelly or cobbly sandy glacial outwash or lacustrine sediment. Textures vary widely within short distances.

Permeability is moderate or moderately rapid from the surface to the lower part of the substratum. It is very rapid through the substratum. Available water capacity is moderate. Effective rooting depth is 60 inches or more. The surface runoff is medium, and the hazard of water erosion is moderate. There is a high hazard of soil blowing.

This unit is used mainly for rangeland and wildlife habitat. Some small areas are used for irrigated orchards, hay, and pasture.

The potential native vegetation is bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. Management of the vegetation for range should be designed to increase the production of bluebunch wheatgrass. Range seeding is suitable if the range is in poor condition. The plants selected for seeding should

be adapted species. The seedbed should be properly prepared, and seeding done with a grass drill. Grazing should be delayed until the more desirable forage plants have achieved sufficient growth to withstand the anticipated intensity of grazing. Management practices suitable for this soil include proper grazing, deferred grazing, and rotation grazing.

When this unit is used for irrigated cropland, the main limitation is slope, soil droughtiness, and soil blowing.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Cover crops can reduce the water erosion and soil blowing in orchards. Cover crops also improve fertility and reduce crusting.

Sprinklers are the most suitable method of applying irrigation water. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

The most suitable wildlife habitat occurs along the perimeter of orchards where there are brush piles or patches of grassy and shrubby vegetation.

This unit is in capability subclass IVe, irrigated, and VIe, nonirrigated.

47—Heytou very stony loam, 0 to 30 percent slopes. This very deep, well drained soil is on basalt plateaus. It formed in glacial till mixed with loess in the surface layer. Native vegetation is bunchgrass and sagebrush. Elevation is 1,000 to 3,000 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 49 degrees F, and the frost-free season is 135 to 165 days.

Typically, the surface layer is grayish brown very stony loam about 10 inches thick. The subsoil is dark brown very cobbly loam about 9 inches thick. The substratum is gray, light gray, and grayish brown very cobbly loam to a depth of 60 inches or more.

Included with this soil in mapping are areas of Timentwa loam, 0 to 15 percent slopes, that make up as much as 10 percent of the unit. Also included are areas of Bakeoven soils; Haploxerolls, nearly level; Aquolls, nearly level; and Rock outcrop that make up as much as 5 percent of the unit.

Permeability of this Heytou soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. The surface runoff is medium, and the water erosion hazard is moderate.

This soil is used mainly for rangeland (fig. 3) and wildlife habitat.

The potential vegetation is bluebunch wheatgrass, needleandthread, balsamroot, and big sagebrush.

The main limitation for rangeland is the very stony surface layer. The vegetation should be managed to increase production of bluebunch wheatgrass and needleandthread. Management practices suitable for this soil are proper grazing, deferred grazing, rotation grazing, and aerial spraying for brush management. Mechanical brush management is not generally practical because of the stones on the surface.

This soil is in capability subclass VIIs, nonirrigated.

48—Kiona-Rubble land association, steep. This unit is on canyon side slopes. It formed in colluvium mixed with loess. Slope is 25 to 70 percent. Native vegetation is mainly grass and sagebrush. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 7 to 9 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 140 to 210 days.

This unit is about 60 percent Kiona extremely stony loam, 25 to 70 percent slopes, and 15 percent Rubble land. The Kiona soils are on the canyon side slopes and the Rubble land is on small talus areas immediately below the rock outcrop escarpments.

Included with this unit in mapping are areas of Bakeoven, Beverly, Ralls, and Renslow soils and Rock outcrop escarpments that make up 25 percent of the unit.

Typically, the Kiona soil is very deep and well drained. It has a yellowish brown, extremely stony loam surface layer about 5 inches thick. The subsoil is yellowish brown very cobbly silt loam about 15 inches thick. The substratum is yellowish brown very cobbly silt loam to a depth of 60 inches or more.

Permeability of this Kiona soil is moderate. Available water capacity is moderate. Effective rooting depth is 60 inches or more. The surface runoff is rapid, and the water erosion hazard is high.

Rubble land consists of loose basalt cobbles, stones, and boulders several feet thick underlain by a mixture of gravel, cobbles, stones, and soil material. This unit supports no vegetation other than scattered serviceberry. The surface runoff is slow, and the water erosion hazard is low.

This unit is used for rangeland and wildlife habitat.

The main limitation of the Kiona soil for rangeland is the slope and extremely stony surface layer. The potential native vegetation on the Kiona soil consists of bluebunch wheatgrass, Thurber needlegrass, Sandberg bluegrass, and big sagebrush. Management of the vegetation should be designed to increase the production of bluebunch wheatgrass. Proper grazing management can improve deteriorated range. Management practices suitable for this unit are proper grazing, deferred grazing, rotation grazing, aerial spraying for brush management, and water development. Brush management by mechanical methods is generally not practical because of the steep slopes and stones and cobbles on the surface.

The Kiona extremely stony loam, 25 to 70 percent slopes, is in capability subclass VIIs, nonirrigated. Rubble land is in VIIIs.

49—Magallon fine sandy loam, 3 to 8 percent slopes. This very deep, somewhat excessively drained soil is mainly on high, broad terraces. It formed in glacial outwash mixed with loess in the surface layer. Native vegetation is grass and shrubs. Individual areas of this unit are somewhat circular in shape and range in size

Figure 3.—Heytou very stony loam, 0 to 30 percent slopes, the soil in the foreground, is used mainly for rangeland and wildlife habitat. In the background is Dinkels gravelly loam, 25 to 70 percent slopes.

from 15 to 800 acres. Elevation is 700 to 1,500 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 175 days.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is yellowish brown fine sandy loam about 9 inches thick. The substratum is light yellowish brown loamy fine sand and fine sand to a depth of 60 inches or more. Depth to the sandy layers ranges from 20 to 36 inches.

Included with this soil in mapping are small areas of Cashmere, Pogue, and Quincy soils. The Cashmere and Pogue soils are generally on downslopes in the East Wenatchee area. The Quincy soil occurs as small sandy spots. Also included are small areas with slopes of 0 to 3 percent and some areas with a sandy loam surface layer.

Permeability of this Magallon soil is moderately rapid to a depth of about 19 inches and rapid below that. Available water capacity is moderate. Effective rooting depth is 60 inches or more. The surface runoff is slow, and the water erosion hazard is slight. There is a high hazard of soil blowing. The surface layer is friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches,

apricots, and cherries are also grown. Some areas are also used for irrigated hay, pasture, nursery stock production, nonirrigated cropland, and homesites.

The main limitations for cropland are the slope, hazard of soil blowing, and soil droughtiness.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Cover crops improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 2.5 inches of water should be applied every 8 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. Because the soil is droughty, light and frequent applications of water are needed. If furrow irrigation methods are used, the furrows should be placed on the contour, or across the slope.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper range management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

A small acreage of this soil is in nonirrigated cropland. It is used for a grain summer-fallow system. Rainfall is too low to support annual cropping. Erosion can be reduced if stubble mulch tillage is used and waterways are shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and winter wheat is seeded early.

This soil is well suited to homesites, but it is a poor filter for septic tank absorption fields.

This soil is in capability subclass IIIe, irrigated, and IVe, nonirrigated.

50—Magallon fine sandy loam, 8 to 15 percent slopes. This very deep, somewhat excessively drained soil is mostly near the edges of high, broad terraces. It formed in glacial outwash mixed with loess in the surface layer. Native vegetation is bunchgrass and shrubs. Individual areas of this soil are somewhat circular in shape and range in size from 5 to 50 acres. Elevation is 700 to 1,500 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 175 days.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is yellowish brown fine sandy loam about 9 inches thick. The substratum is light yellowish brown loamy fine sand and fine sand to a depth of 60 inches or more. Depth to the sand layers ranges from 20 to 36 inches.

Included with this soil in mapping are small areas of Cashmere, Pogue, and Quincy soils. The Cashmere and Pogue inclusions generally occur on the western side of the East Wenatchee area. The Quincy soil occurs on small sandy spots.

Permeability of this Magallon soil is moderately rapid to a depth of about 19 inches and rapid below that. Available water capacity is moderate. Effective rooting depth is 60 inches or more. The surface runoff is medium, and the water erosion hazard is moderate. There is a high hazard of soil blowing. The surface layer is friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, nursery stock production, and homesites. A small acreage is nonirrigated cropland.

The main limitations for cropland are the slope, hazard of soil blowing, and soil droughtiness.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Cover crops can reduce water erosion and soil blowing. Cover crops improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 2.5 inches of water should be applied every 8 days at a rate of 0.35 inch per hour for sprinkler irrigation of mature orchards. Sprinklers are the most suitable method of irrigation. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

This soil is used for a grain summer-fallow system. Rainfall is too low to support annual cropping. Erosion can be reduced by stubble mulch tillage, waterways shaped and seeded to perennial grass, stubble fields chiseled in fall, and winter wheat is seeded early.

Slope is the main limitation for homesites. This soil is a poor filter for septic tank absorption fields. The excessive permeability rate can result in pollution of ground water.

This soil is in capability subclass IVe, irrigated, and IVe, nonirrigated.

51—Malaga gravelly fine sandy loam, 0 to 8 percent slopes. This very deep, somewhat excessively drained soil is mainly on terraces. It formed in alluvium mixed with loess overlying glacial outwash. Elevations are 600 to 1,000 feet. The native vegetation is grasses and shrubs. Individual areas of this soil are somewhat oblong in shape and range in size from 3 to 300 acres. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 180 to 195 days.

Typically, the surface layer is brown gravelly fine sandy loam about 4 inches thick. The upper part of the subsoil is dark brown gravelly fine sandy loam about 8 inches thick. The lower part of the subsoil is brown extremely gravelly fine sandy loam about 16 inches thick. The substratum is multicolored extremely gravelly sand to a

depth of 60 inches or more. Depth to the extremely gravelly sand layer ranges from 16 to 28 inches.

Included with this soil in mapping are small areas of Pogue and Quincy soils and areas that have a fine sandy loam or cobbly fine sandy loam surface layer.

Permeability of this Malaga soil is moderately rapid to a depth of 28 inches and very rapid below that. Available water capacity is low. Effective rooting depth is 60 inches or more. The surface runoff is slow, and the water erosion hazard is slight. There is a moderate hazard of soil blowing. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

The main limitations for irrigated orchards are soil droughtiness and small stones.

Cover crops improve fertility, reduce crusting, and increase water infiltration. At the peak of the growing season, about 2.5 inches of water should be applied every 5 days at a rate of 0.5 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. Because this soil is droughty, light and frequent applications of water are needed.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

The main limitation for homesites is the large stones in the soil profile. This soil is a poor filter for septic tank absorption fields. The excessive permeability rate can result in pollution of ground water.

This soil is in capability subclass IIIe, irrigated.

52—Malaga cobbly fine sandy loam, 0 to 8 percent slopes. This very deep, somewhat excessively drained soil is mainly on terraces. It formed in alluvium mixed with loess overlying glacial outwash. The native vegetation is mainly grasses and shrubs. Individual areas of this soil are somewhat oblong in shape and range in size from 4 to 80 acres. Elevations are 600 to 1,000 feet. The average annual precipitation is about 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 180 to 195 days.

Typically, the surface layer is brown cobbly fine sandy loam about 4 inches thick. The upper part of the subsoil is dark brown gravelly fine sandy loam about 8 inches thick. The lower part of the subsoil is brown extremely gravelly fine sandy loam about 16 inches thick. The substratum is extremely gravelly sand to a depth of 60 inches or more. Depth to the extremely gravelly sand layer ranges from 16 to 28 inches.

Included with this soil in mapping are small areas of Pogue and Quincy soils, small areas that have a fine sandy loam or gravelly fine sandy loam surface layer, and small areas that have slopes of 8 to 15 percent.

Permeability of this Malaga soil is moderately rapid to a depth of 28 inches and very rapid below that. Available water capacity is low. The effective rooting depth is 60 inches or more. The surface runoff is slow, and the water erosion hazard is slight. There is a moderate hazard of soil blowing. The surface layer is very friable.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

The main limitations for irrigated orchards are the surface cobbles and soil droughtiness.

Cover crops improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 1.6 inches of water should be applied every 5 days at a rate of 0.5 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. Because this soil is droughty, light and frequent applications of water are needed. Care will be needed when cutting the cover crop and mowing hay because the cobbles on the surface can damage equipment.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help to keep the pasture and soil in good condition.

The main limitation for homesites is the large stones in the soil profile. This soil is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of ground water.

This soil is in capability subclass IVe, irrigated.

53—Pits, gravel. Pits, gravel, is mostly on terraces and fans. Individual areas are irregular in shape and range from 3 to more than 20 acres in size. These are areas where sand, gravel, or sand and gravel have been removed. They commonly have very steep banks on one or more sides and a nearly level to gently sloping bottom.

Most areas are devoid of vegetation and are idle or are being actively used as sources of sand and gravel.

This unit is in capability subclass VIIIs, nonirrigated.

54—Pogue fine sandy loam, 0 to 3 percent slopes. This very deep, somewhat excessively drained soil is mainly on terraces. It formed in alluvium mixed with loess overlying glacial outwash. Native vegetation is grasses and shrubs. Individual areas of this soil are somewhat oblong in shape and range from 3 to 450 acres in size.

Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 180 days.

Typically, the surface layer is grayish brown fine sandy loam about 6 inches thick. The subsoil is brown cobbly fine sandy loam about 25 inches thick. The substratum is very cobbly sand to a depth of 60 inches or more. Depth to the very cobbly sand ranges from 24 to 38 inches.

Included with this soil in mapping are small areas of Burbank, Cashmere, and Quincy soils and small areas that have a gravelly or cobbly surface layer.

Permeability of this Pogue soil is moderately rapid to a depth of about 31 inches and very rapid below that. Available water capacity is moderate. The effective rooting depth is 60 inches or more. The surface runoff is very slow, and the water erosion hazard is slight. There is a high hazard of soil blowing. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

The main limitations for irrigated orchards are the high hazard of soil blowing and soil droughtiness.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Cover crops can reduce soil blowing in orchards. Cover crops also improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 2.4 inches of water should be applied every 8 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

This soil is well suited to urban development, but it is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of the ground water.

This soil is in capability subclass IIIe, irrigated.

55—Pogue fine sandy loam, 3 to 8 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in alluvium mixed with loess overlying glacial outwash. Native vegetation is grasses and shrubs. Individual areas of this soil are somewhat oblong in shape and range in size from 2 to 950 acres. Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 180 days.

Typically, the surface layer is grayish brown fine sandy loam about 6 inches thick. The subsoil is brown cobbly fine sandy loam about 25 inches thick. The substratum is very cobbly sand that extends to a depth of 60 inches or more. Depth to the very cobbly sand ranges from 24 to 38 inches.

Included with this soil in mapping are small areas of Burbank, Cashmere, Magallon, and Quincy soils, small areas that have a gravelly or cobbly surface layer, and several small areas that have slopes of 0 to 3 percent. The C horizon is fine gravelly sand in the area near Pangborn Airfield.

Permeability of this Pogue soil is moderately rapid to a depth of about 31 inches and very rapid below that. Available water capacity is moderate. The effective rooting depth is 60 inches or more. The surface runoff is slow, and the water erosion hazard is slight. There is a high hazard of soil blowing. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay and pasture and homesites.

The main limitations for irrigated croplands are the slope, hazard of soil blowing, and soil droughtiness.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Cover crops can reduce soil blowing in orchards. Cover crops also improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 2.4 inches of water should be applied every 8 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. If furrow irrigation methods are used, the furrows should be on the contour, or across the slope.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

This soil is well suited to homesites, but is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of the ground water.

This soil is in capability subclass IIIe, irrigated.

56—Pogue gravelly fine sandy loam, 8 to 15 percent slopes. This very deep, somewhat excessively drained soil is mostly on terraces. It formed in alluvium mixed with loess overlying glacial outwash. The native vegetation is mainly grasses and shrubs. Individual areas of this soil are somewhat oblong in shape and range in size from 2 to 150 acres. Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 180 days.

Typically, the surface layer is grayish brown gravelly fine sandy loam about 6 inches thick. The subsoil is

brown and yellowish brown cobbly fine sandy loam about 25 inches thick. The substratum is a very cobbly sand to a depth of 60 inches or more. Depth to the very cobbly sand ranges from 24 to 38 inches.

Included with this soil in mapping are small areas of Burbank, Cashmont, and Quincy soils and small areas that have a fine sandy loam or cobbly fine sandy loam surface layer.

Permeability of this Pogue soil is moderately rapid to a depth of about 31 inches and very rapid below that. Available water capacity is moderate. The effective rooting depth is 60 inches or more. The surface runoff is medium, and the water erosion hazard is moderate. There is a moderate hazard of soil blowing. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

The main limitations when using these soils for irrigated cropland are the slope and soil droughtiness. Cover crops can reduce water erosion in orchards.

Cover crops also improve fertility, reduce crusting, and increase water infiltration. Care will be needed when cutting the cover crop or mowing hay because the gravel on the surface can damage equipment.

At the peak of the growing season, about 1.8 inches of irrigation water should be applied every 6 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Because of the slope, sprinklers are the most suitable method of irrigation. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

Slope is the main limitation for homesites. This soil is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of ground water.

This soil is in capability subclass IVe, irrigated.

57—Pogue gravelly fine sandy loam, 15 to 25 percent slopes. This very deep, somewhat excessively drained soil is mainly on terraces and side slopes of terraces. It formed in alluvium mixed with loess overlying glacial outwash. The native vegetation is mainly grasses and shrubs. Individual areas of this soil are somewhat oblong in shape and range in size from 4 to 40 acres. Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 180 days.

Typically, the surface layer is brown gravelly fine sandy loam about 6 inches thick. The subsoil is brown and yellowish brown cobbly fine sandy loam about 25 inches thick. The substratum is very cobbly sand to a depth of 60 inches or more. Depth to the very cobbly sand ranges from 20 to 36 inches.

Included with this soil in mapping are small areas of Cashmere, Magallon, and Malaga soils. Also included are small areas that have a fine sandy loam surface layer.

Permeability of this Pogue soil is moderately rapid to a depth of about 31 inches and very rapid below that. Available water capacity is moderate. The effective rooting depth is 60 inches or more. The surface runoff is medium, and the hazard of water erosion is moderate. There is a moderate hazard of soil blowing. The surface layer is friable and easily tilled.

The main limitations for irrigated cropland are the slope and soil droughtiness. The slope limits the accessibility and maneuverability of ground equipment used in the production and harvesting of orchard crops.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

Cover crops can reduce water erosion in orchards and improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 1.8 inches of irrigation water should be applied every 6 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Because of the slope, sprinklers are the most suitable method of irrigating. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients and surface runoff.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

The main limitation for homesites is the slope. The slope and poor filtering properties of the soil are the main limitations for septic tank absorption fields. The excessive permeability can result in pollution of ground water. Absorption lines should be installed on the contour.

This soil is in capability subclass IVe, irrigated.

58—Pogue cobbly fine sandy loam, 0 to 15 percent slopes. This very deep, somewhat excessively drained soil is mainly on lower terraces. It formed in alluvium mixed with loess overlying glacial outwash. The native vegetation is mainly grasses and shrubs. Individual areas of this unit are somewhat oblong in shape and range in size from 2 to 140 acres. Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 180 days.

Typically, the surface layer is grayish brown cobbly fine sandy loam about 6 inches thick. The subsoil is brown cobbly fine sandy loam about 25 inches thick. The substratum is very cobbly sand to a depth of 60 inches or more. Depth to the very cobbly sand ranges from 24 to 38 inches.

Included are small areas of Burbank, Cashmere, Magallon, and Quincy soils and small areas that have a gravelly, stony, or fine sandy loam surface layer. Several small areas that have slopes of 15 to 25 percent are also included.

Permeability of this Pogue soil is moderately rapid to a depth of about 31 inches and very rapid below that. Available water capacity is moderate. The effective rooting depth is 60 inches or more. The surface runoff is medium, and the water erosion hazard is moderate. There is a moderate hazard of soil blowing. The surface layer is very friable.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

The main limitations for irrigated cropland are the slope, cobbly surface layer, and soil droughtiness.

Cover crops can reduce water erosion in orchards and improve fertility, reduce crusting, and increase water infiltration. Care will be needed when cutting the cover crop or mowing hay because the cobbles on the surface can damage equipment.

At the peak of the growing season, about 1.6 inches of irrigation water should be applied every 5 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Sprinklers are the most suitable method of irrigating. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients and surface runoff.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

The slope and cobbles in the soil profile are the main limitations for homesites. This soil is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of ground water.

This soil is in capability subclass IVe, irrigated.

59—Pogue extremely stony fine sandy loam, 3 to 25 percent slopes. This very deep, somewhat excessively drained soil is mostly on low terraces. It formed in alluvium mixed with loess overlying glacial outwash. The native vegetation is mainly grasses and shrubs. Individual areas of this unit are somewhat oblong in shape and range in size from 5 to 400 acres. Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 180 days.

Typically, the surface layer is grayish brown extremely stony fine sandy loam about 6 inches thick. The subsoil is brown cobbly fine sandy loam about 25 inches thick. The substratum is very cobbly sand to a depth of 60 inches or more. Depth to the very cobbly sand ranges from 24 to 38 inches.

Included are small areas of Burbank, Cashmere, Magallon, and Quincy soils and small areas that have a gravelly or cobbly fine sandy loam surface layer.

Permeability of this Pogue soil is moderately rapid to a depth of about 31 inches and very rapid below that. Available water capacity is moderate. The effective rooting depth is 60 inches or more. The surface runoff is medium, and the water erosion hazard is moderate. There is a moderate hazard of soil blowing. The surface layer is very friable.

This soil is used mainly for rangeland. Some areas are used for irrigated apple orchards, irrigated pasture, and homesites.

The main limitations for irrigated cropland are the slope, extremely stony soil surface, and soil droughtiness.

Cover crops can reduce water erosion in orchards and improve fertility, reduce crusting, and increase water infiltration. Extreme care is needed when cutting the cover crop because the stones on the surface can damage equipment.

At the peak of the growing season, about 1.6 inches of irrigation water should be applied every 5 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Because of the slope and extremely stony surface layers, sprinklers are the most efficient method of irrigating. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients and surface runoff.

The main limitation for rangeland is the extremely stony surface layer.

The potential native vegetation is bluebunch wheatgrass, needleandthread and Sandberg bluegrass. Management of the vegetation for rangeland should be designed to increase the production of the bluebunch wheatgrass. Proper grazing can improve deteriorated range. Other practices suitable for this soil are deferred grazing, rotation grazing, aerial spraying for brush management, and water development.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

The main limitations for urban development are the stones in the soil profile and slope. This soil is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of ground water.

This soil is in capability subclass VIs, irrigated, and VIIs, nonirrigated.

60—Pogue bouldery fine sandy loam, 3 to 8 percent slopes. This very deep, somewhat excessively drained soil is mainly on low terraces. It formed in alluvium mixed with loess overlying glacial outwash. The native vegetation is mainly grass and shrubs. Individual areas of this soil are somewhat irregular in shape and range in size from 10 to 200 acres. Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 180 days.

Typically, the surface layer is grayish brown bouldery fine sandy loam about 6 inches thick. The subsoil is brown cobbly fine sandy loam about 25 inches thick. The substratum is very cobbly sand to a depth of 60 inches or more. Depth to the very cobbly sand ranges from 24 to 38 inches. The soil profile may be bouldery.

Included are small areas of Burbank, Cashmere, and Quincy soils and small areas that have a gravelly, cobbly, or stony fine sandy loam surface layer. Some small areas have slopes of 8 to 15 percent.

Permeability of the Pogue soil is moderately rapid to a depth of about 31 inches and very rapid below that. Available water capacity is moderate. The effective rooting depth is 60 inches or more. The surface runoff is slow, and the water erosion hazard is slight. There is a moderate hazard of soil blowing.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for rangeland, irrigated pasture, and homesites.

The main limitations for orchards are the slope, bouldery surface layer, and soil droughtiness.

Cover crops can reduce water erosion in orchards and improve fertility, reduce crusting, and increase water infiltration. Care is needed when cutting the cover crop or mowing hay because the boulders can damage equipment.

At the peak of the growing season, about 1.6 inches of irrigation water should be applied every 5 days at a rate of 0.4 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

The main limitation for rangeland is the bouldery surface layer.

The potential native vegetation is bluebunch wheatgrass, needleandthread and Sandberg bluegrass. Management of the vegetation for range should be designed to increase production of bluebunch wheatgrass. Proper grazing can improve deteriorated range. Other practices suitable for this soil are deferred grazing, rotation grazing, aerial spraying for brush management, and water development.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

The boulders are a major limitation for homesites. This soil is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of ground water.

This soil is in capability subclass VIs, irrigated, and VIIs, nonirrigated.

61—Pogue loam, 8 to 15 percent slopes. This very deep, somewhat excessively drained soil is mainly on high terraces. It formed in alluvium mixed with loess overlying glacial outwash. The native vegetation is mainly grass and shrubs. Individual areas of this soil are somewhat oblong in shape and range in size from 5 to 18 acres. Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 180 days.

Typically, the surface layer is brown loam about 10 inches thick. The subsoil is brown loam and gravelly loam about 15 inches thick. The substratum is very cobbly sand to a depth of 60 inches or more. Depth to the sand ranges from 20 to 40 inches.

Included with this soil in mapping are small areas of Cashmere, Magallon, and Renslow soils. Also included are small areas that have a silt loam or gravelly silt loam surface layer.

Permeability of this Pogue soil is moderately rapid to a depth of about 25 inches and very rapid below that. Available water capacity is moderate. Effective rooting depth is 60 inches or more. The surface runoff is medium, and the hazard of water erosion is moderate. The surface layer is friable and easily tilled.

This soil is used mainly for nonirrigated croplands. Some areas are used for irrigated orchards, irrigated hay, pasture, and homesites. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown.

When used for nonirrigated cropland, the main crop is winter wheat in a summer-fallow system. Precipitation is generally too low to support annual cropping. Erosion can be reduced on nonirrigated cropland if stubble mulch tillage is used, waterways are shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and winter wheat is seeded early.

When used for irrigated cropland, the main limitations are the slope and soil droughtiness.

Cover crops can reduce water erosion in orchards and improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 2.5 inches of water should be applied every 9 days at a rate of 0.3 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the

root zone but small enough to minimize the leaching of plant nutrients and surface runoff.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

Slope is the main limitation for homesites. This soil is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of ground water.

This soil is in capability subclass IVe, irrigated, and IIIe, nonirrigated.

62—Quincy fine sand, 15 to 25 percent slopes. This very deep, somewhat excessively drained soil is on terraces and side slopes of terraces. It formed in wind-deposited sand. The native vegetation is grasses and shrubs. Individual areas of this soil are generally oblong in shape and range in size from 3 to 50 acres. Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 135 to 180 days.

Typically, the surface layer is grayish brown fine sand about 10 inches thick. The underlying material is light brownish gray fine sand to a depth of 60 inches or more. In places the underlying material below a depth of 40 inches is old alluvium, lacustrine deposits, outwash gravel, or glacial till.

Included with this soil in mapping are small areas of Burbank, Cashmere, Pogue, and Supplee soils and small areas that have a loamy fine sand or gravelly loamy coarse sand surface layer. Also included are small areas of sand dunes and blowout areas.

Permeability of this Quincy soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. The surface runoff is medium, and the water erosion hazard is moderate. There is a high hazard of soil blowing. The surface layer is very friable and easily tilled.

This soil is used for irrigated orchards, rangeland, irrigated hay and pasture, and homesites. Apple orchards predominate, but some peaches, pears, apricots, and cherries are also grown.

When this soil is used for irrigated cropland the main limitations are the slope, soil blowing hazard, and soil droughtiness.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Cover crops can reduce water erosion and soil blowing in orchards, but are difficult to establish. Seeding in late August or September along with light daily irrigation for two weeks and additions of manure or straw to the soil will help the establishment of cover crops. Cover crops also improve fertility and increase the available water capacity.

At the peak of the growing season, about 1.6 inches of water should be applied every 5 days at a rate of 0.5 inch per hour for sprinkler irrigation of mature orchards. Sprinklers are the most efficient method of irrigation. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. Because this soil is droughty, light and frequent applications of water are needed.

The main limitations for rangeland are the soil droughtiness and soil blowing.

The potential vegetation is needleandthread, Indian ricegrass, Sandberg bluegrass, thickspike wheatgrass, and antelope bitterbrush.

Management of vegetation for range should be designed to increase production of needleandthread and Indian ricegrass. Proper grazing can improve deteriorated range. Other practices suitable for this soil are deferred grazing, rotation grazing, aerial spraying for brush management, and water development. Livestock should be carefully managed to protect this soil from blowing.

The main limitation for homesites is the slope. This soil is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of ground water.

This soil is in capability subclass IVe, irrigated, and VIIe, nonirrigated.

63—Quincy loamy fine sand, 0 to 15 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in wind-deposited sand. Individual areas of this soil are irregular in shape and range in size from 3 to 350 acres. Native vegetation is grasses and shrubs. Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 135 to 180 days.

Typically, the surface layer is grayish brown loamy fine sand about 10 inches thick. The underlying material is light brownish gray fine sand to a depth of 60 inches or more. In places the underlying material below a depth of 40 inches is old alluvium, lacustrine deposits, outwash gravel, or glacial till.

Included are small areas of Burbank, Cashmere, and Supplee soils and small areas that have boulders on the surface or a gravelly loamy coarse sand surface layer. Also included are long, narrow, somewhat poorly drained areas immediately adjoining manmade lakes.

Permeability of this Quincy soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. The surface runoff is slow, and the water erosion hazard is slight. There is a high hazard of soil blowing.

This unit is used mainly for irrigated orchards. Apple orchards predominate, but some peaches, pears, apricots, and cherries are also grown. Some areas are also used for irrigated hay and pasture, rangeland, and homesites.

When this soil is used for irrigated orchards the main limitations are the slope, hazard of soil blowing, and soil droughtiness.

To reduce soil blowing, care should be taken not to leave areas of soil unprotected. Cover crops can reduce water erosion in orchards, but are somewhat difficult to establish. Seeding in late August or September along with light daily irrigation for about two weeks and additions of manure or straw to the soil will help the establishment of cover crops. Cover crops improve fertility.

At the peak of the growing season, about 1.8 inches of water should be applied every 6 days at a rate of 0.5 inch per hour for sprinkler irrigation of mature orchards. Sprinklers are the most efficient method of irrigation. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. Because this soil is droughty, light and frequent applications of water are needed.

The main limitations for rangeland are soil droughtiness and soil blowing.

The potential native vegetation is needleandthread, Indian ricegrass, Sandberg bluegrass, thickspike wheatgrass, and antelope bitterbrush.

Management of vegetation for range should be designed to increase production of needleandthread and Indian ricegrass. Proper grazing can improve deteriorated range. Other practices suitable for this soil are deferred grazing, rotation grazing, aerial spraying for brush management, and water development. Livestock should be carefully managed to protect this soil from blowing.

Slope is the main limitation for urban development. This soil is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of ground water.

This soil is in capability subclass IVe, irrigated, and VIIe, nonirrigated.

64—Ralls-Renslow-Bakeoven association, steep. This unit is on basalt plateaus and side slopes. It formed in colluvium mixed with loess. Slope is 3 to 65 percent. The native vegetation is mainly grass and sagebrush. Elevation is 1,500 to 3,000 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 49 degrees F, and the frost-free season is 140 to 180 days.

This unit is about 60 percent Ralls very cobbly silt loam, 25 to 65 percent slopes; 15 percent Renslow silt loam, 15 to 30 percent slopes; and 10 percent Bakeoven extremely cobbly loam, 3 to 25 percent slopes. The Ralls soil is mainly on hillsides. The Renslow soil is in small, flatter areas. The Bakeoven soil is mostly in long, narrow strips near canyon rims.

Included with this unit in mapping are areas of Badge, Dinkels, Lickskillet, and Zen soils and some small areas of Rock outcrop and Rubble land. These included areas make up 15 percent of the unit.

The Ralls soil is very deep and well drained. It formed in colluvium mixed with loess. Typically, it has a grayish brown, very cobbly silt loam surface layer about 10 inches thick. The subsoil is dark brown gravelly clay loam and yellowish brown gravelly silt loam about 22 inches thick. The substratum is yellowish brown very gravelly silt loam to a depth of 60 inches or more.

Permeability of this Ralls soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is rapid, and the hazard of water erosion is high.

The Renslow soil is very deep and well drained. It formed in loess. Typically, it has a brown, silt loam surface layer about 10 inches thick. The subsoil is yellowish brown and light yellowish brown silt loam about 21 inches thick. The substratum is yellowish brown silt loam to a depth of 60 inches or more.

Permeability of this Renslow soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is rapid, and the water erosion hazard is high.

The Bakeoven soil is shallow and well drained. It formed in basalt, colluvium, and alluvium mixed with loess. Typically, it has a brown, very cobbly loam surface layer about 4 inches thick. The subsoil is yellowish brown very gravelly heavy loam and very gravelly clay loam about 5 inches thick over basalt. Depth to the basalt ranges from 4 to 12 inches.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is low. Effective rooting depth is 4 to 12 inches. Surface runoff is medium, and the water erosion hazard is moderate.

This unit is used mainly for rangeland and wildlife habitat.

The main limitations of this unit for rangeland are slope, cobbles on the surface of the Ralls and Bakeoven soils, and the shallow rooting depth of the Bakeoven soil.

The Ralls and Renslow soils have a potential native vegetation of bluebunch wheatgrass, Indian fescue, and Sandberg bluegrass. The potential native vegetation on the Bakeoven soil is mostly Sandberg bluegrass and stiff sagebrush.

Management of the vegetation should be designed to increase production of bluebunch wheatgrass on the Ralls and Renslow soils and maintain the stand of Sandberg bluegrass on the Bakeoven soil. Proper grazing management can improve deteriorated range. Other practices suitable for this unit are deferred grazing, rotation grazing, aerial spraying for brush management, and water development.

The Ralls soil is in capability subclass VIIs, nonirrigated; the Renslow soil is in IVe, nonirrigated; and the Bakeoven soil is in VIIs, nonirrigated.

65—Renslow-Dougville association, undulating. This unit is on the basalt plateau. The soils formed in loess, mixed with some volcanic ash and cinders. Slope is 0 to 30 percent. Native vegetation is mainly bunchgrass and sagebrush. Elevation is 2,400 to 3,200 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 49 degrees F, and the frost-free season is 140 to 180 days.

This unit is about 40 percent Renslow silt loam, 0 to 15 percent slopes; 30 percent Dougville loam, 0 to 15 percent slopes; and 25 percent Renslow silt loam, 15 to 30 percent slopes. The Renslow soils are on the steeper south- and west-facing slopes, and the Dougville soil is on flatter areas and the north-facing slopes.

Included with this unit in mapping are areas of Broadax, Lickskillet, and Willis soils. These included areas make up about 5 percent of the unit.

Renslow soils are very deep and well drained. They formed in loess. Typically, they have a brown silt loam surface layer about 10 inches thick. The subsoil is yellowish brown and light yellowish brown silt loam about 21 inches thick. The substratum is yellowish brown silt loam that extends to a depth of 60 inches or more.

Permeability of the Renslow soils is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate on the Renslow silt loam, 0 to 15 percent slopes. Surface runoff is rapid and the water erosion hazard is high on the Renslow silt loam, 15 to 30 percent slopes.

The Dougville soil is very deep and well drained. It formed in loess mixed with volcanic ash and cinders. Typically, it has a grayish brown, loam surface layer about 9 inches thick. The subsoil is brown loam about 15 inches thick. The upper part of the substratum is brown loam about 18 inches thick, and the lower part is light yellowish brown heavy silt loam to a depth of 60 inches or more.

Permeability of the Dougville soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for nonirrigated cropland and wildlife habitat. A few areas are used for rangeland.

The main crop is winter wheat in a summer-fallow system. Precipitation is generally too low to support annual cropping. Erosion can be reduced on nonirrigated cropland if stubble mulch tillage is used, waterways are shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and winter wheat is seeded early.

When this unit is used for rangeland the potential native vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and Cusick bluegrass on the Renslow soils and bluebunch wheatgrass, Sandberg bluegrass, balsamroot, and big sagebrush on the Dougville soil. Management of the vegetation should be designed to increase production of bunchgrass and Idaho fescue.

Proper grazing management can improve deteriorated range. Brush management by aerial spraying or mechanical means can also encourage increased grass production. If the range is seriously deteriorated, seeding is needed. The plants selected for seeding should be adapted species. The seedbed should be properly prepared and seeded with a grass drill. Grazing should be delayed until the more desirable plants have achieved sufficient growth to withstand the anticipated intensity of grazing. Other practices suitable for this unit include deferred grazing, rotation grazing, and water development.

The Renslow silt loam, 0 to 15 percent slopes, is in capability subclass IIIe, nonirrigated; the Dougville loam, 0 to 15 percent slopes, is in IIIe, nonirrigated; and the Renslow silt loam, 15 to 30 percent slopes, is in IVe, nonirrigated.

66—Renslow-Zen association, undulating. This unit is on the basalt plateaus. The soils formed in loess. Slope is 0 to 15 percent. Elevation is 2,000 to 3,200 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 49 degrees F, and the frost-free season is 140 to 180 days.

This unit is about 65 percent Renslow silt loam, 0 to 15 percent slopes, and 25 percent Zen silt loam, 0 to 15 percent slopes. The Renslow soil occurs in the swales and on north and east slopes. The Zen soil is commonly on low ridges and knolls.

Included with this unit in mapping are small areas of Renslow soils with short slopes of 15 to 30 percent. Up to 10 percent of this unit is areas of Broadax, Condon, Dougville, Lickskillet, and Ralls soils. Also included are small areas of a soil that is calcarous in the surface layer and a moderately well drained soil in depressions.

The Renslow soil is very deep and well drained. It formed in loess. Typically, it has a brown, silt loam surface layer about 10 inches thick. The subsoil is yellowish brown and light yellowish brown silt loam about 21 inches thick. The substratum is yellowish brown silt loam that extends to a depth of 60 inches or more.

Permeability of the Renslow soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the hazard of water erosion is moderate.

The Zen soil is moderately deep and well drained. It formed in loess. Typically, it has a brown and dark brown, silt loam surface layer about 18 inches thick. The subsoil is yellowish brown and light yellowish brown silt loam about 16 inches thick. Basalt occurs at a depth of about 34 inches. Depth to the basalt ranges from 20 to 40 inches.

Permeability of the Zen soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for nonirrigated cropland (fig. 4) and wildlife habitat. A few small, isolated areas are irrigated and used for hay, grain, and pasture.

The main crop is winter wheat in a summer-fallow system. Precipitation is generally too low to support annual cropping. Erosion can be reduced on nonirrigated cropland if stubble mulch tillage is used, waterways are shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and winter wheat is seeded early.

The Renslow silt loam, 0 to 15 percent slopes, is in

Figure 4.—Renslow-Zen association, undulating, is used mainly for nonirrigated cropland. A debris basin constructed on this unit collects sediment and debris from surrounding fields during the spring runoff and summer thunderstorms.

capability subclass IIIe, nonirrigated. The Zen silt loam, 0 to 15 percent slopes, is in IIIe, nonirrigated.

67—Rock Creek very cobbly silt loam, 3 to 30 percent slopes. This shallow, well drained soil is on mountain side slopes and ridgetops (fig. 5). It formed in residuum from basalt mixed with loess. Native vegetation is mainly grass and forbs. Elevation is 2,400 to 4,200 feet. The average annual precipitation is 12 to 15 inches, mean annual air temperature is about 47 degrees F, and the frost-free season is 110 to 150 days.

Typically, the surface layer is brown very cobbly silt loam about 3 inches thick. The subsoil is brown very gravelly clay loam and dark brown very gravelly clay and extremely cobbly clay about 9 inches thick. Basalt is at a depth of 12 inches. Depth to the basalt ranges from 8 to 20 inches.

Included with this soil in mapping are areas of Badge, Condon, and Cordy soils and Rock outcrop. These included areas make up 30 percent of the unit. The Condon soil occurs as small biscuitlike mounds scattered throughout the Rock Creek soils.

Permeability of this Rock Creek soil is moderately slow. Available water capacity is low. Effective rooting depth is 8 to 20 inches. Surface runoff is rapid, and the water erosion hazard is high.

This soil is used for rangeland and wildlife habitat. The potential native vegetation is Sandberg bluegrass, eriogonum, stiff sagebrush, and bluebunch wheatgrass.

The main limitations for rangeland are the shallow rooting depth and cobbles on the soil surface.

Management of vegetation should be designed to increase production of bluebunch wheatgrass and maintain the stand of Sandberg bluegrass. Proper grazing management can improve deteriorated range. Other practices suitable for this soil are deferred grazing, rotation grazing, aerial spraying for brush management, and water development.

This soil is in capability subclass VIIs, nonirrigated.

68—Rubble land-Rock outcrop complex. This unit is on colluvial slopes and basalt cliffs. Slope is 25 to 70 percent. Vegetation is sparse with only occasional brush. Elevation is 1,000 to 3,200 feet. The average annual precipitation is 6 to 15 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 145 to 180 days.

This unit is about 80 percent Rubble land and 15 percent Rock outcrop. The Rubble land is mostly on 25 to 70 percent slopes below the Rock outcrop. Generally, the largest boulders are at the bottom of the slopes.

Included with this unit in mapping are areas of Bakeoven, Kiona, Lickskillet, and Ralls soils. These included areas make up about 5 percent of the unit.

The Rubble land consists of loose basalt cobbles, stones, and boulders underlain by a mixture of gravel, cobbles, and stones with sand and silt to a depth of 60 inches or more. The soil material is variable.

Figure 5.—Typical landscape of Rock Creek very cobbly silt loam, 3 to 30 percent slopes.

The Rock outcrop is mostly vertical cliffs of columnar basalt.

This unit is used mainly for wildlife habitat.

This unit is in capability subclass VIIIs, nonirrigated.

69—Umapine Variant loam. This moderately deep, moderately well drained, sodium-affected soil is on low terraces. It formed in alluvium and is in long narrow areas. Slope is 0 to 2 percent. Native vegetation is mainly grass and brush. Elevation is 1,200 to 1,900 feet. The average annual precipitation is 7 to 12 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 120 to 195 days.

Included with this soil in mapping are areas of Ellisforde soils, soils that have no duripan, and soils that are somewhat poorly drained. The soils that have no duripan commonly are immediately adjacent to drainageways. The somewhat poorly drained soils are in the lowest positions.

Typically, the surface layer is pale brown loam about 10 inches thick. The upper part of the underlying material is sodium-affected light brownish gray silt loam 10 inches thick, and the lower part is sodium-affected pale brown loam 9 inches thick over a weakly cemented hardpan at a depth of 29 inches. Beneath the pan from a depth of 36 to 60 inches or more is light gray silt loam. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Umapine Variant soil is moderate above the hardpan and very slow in it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is very slow, and the hazard of water erosion is slight. This soil is generally moderately affected by salt and alkali; some spots are strongly affected (*9*). There is a rare flooding hazard during spring and other runoff periods. This soil has a seasonal high perched water table at a depth of 1.5 to 3.0 feet in winter and spring months.

This soil is used mainly for rangeland and wildlife habitat.

The main limitations for rangeland are wetness and the affect of sodium on plant growth.

The potential native vegetation is inland saltgrass, greasewood, alkali cordgrass, and giant wildrye. There are some slick spots that have no vegetation.

Management of the vegetation should be designed to increase production of the grasses. Brush management by aerial spraying or mechanical means can improve deteriorated range. Range seeding is suitable if the range vegetation is in poor condition. The plants seeded should be adapted species that can tolerate wetness and sodium. For best results, the seedbed should be properly prepared and a grass drill used. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand the expected intensity of grazing. Along with water development, management practices suitable for this soil are proper grazing, deferred grazing, and rotation grazing.

This soil is in capability subclass Vlw, nonirrigated.

70—Strat very cobbly silt loam, 3 to 25 percent slopes. This very deep, well drained soil is on outwash plains and terraces. It formed in glacial outwash mixed with loess in the upper part. Native vegetation is mainly bunchgrass and sagebrush. Elevation is 1,200 to 1,850 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 49 degrees F, and the frost-free season is 140 to 180 days.

Included with this soil in mapping are areas of Bakeoven, Esquatzel, and Kiona soils and small areas of Rock outcrop. These included areas make up 10 percent of the unit.

Typically, the surface layer is brown very cobbly silt loam about 10 inches thick. The subsoil is pale brown very cobbly loam about 8 inches thick. The upper part of the substratum is yellowish brown very gravelly loam about 4 inches thick, and the lower part is yellowish brown extremely gravelly sand to a depth of 60 inches or more.

Permeability of this Strat soil is moderate to a depth of about 22 inches and very rapid below that. Available water capacity is low. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate.

This soil is used mainly for rangeland and wildlife habitat.

The main limitations for rangeland are the very cobbly surface layer and soil droughtiness.

The potential native vegetation is bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush.

Management of vegetation should be designed to increase production of the grasses. Brush management by aerial spraying and mechanical means can improve deteriorated range. Mechanical brush management and seeding is practical, but some difficulty is encountered from the cobbles and stones on the surface. If the range is seriously deteriorated, seeding is needed. The plants selected for seeding should be adapted species. For best results, the seedbed should be properly prepared and a grass drill used. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand the expected intensity of grazing. Management practices suitable for this soil include proper grazing, deferred grazing, rotation grazing, and water development.

This soil is in capability subclass Vls, nonirrigated.

71—Supplee very fine sandy loam, 3 to 8 percent slopes. This very deep, well drained soil is on terraces. It formed in loess, volcanic ash, and pumice over glacial outwash. Native vegetation is mainly grass and shrub. Individual areas of this soil are irregular in shape and range in size from 2 to 120 acres. Elevation is 1,000 to 1,700 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 150 to 200 days.

Typically, the surface layer is light brownish gray very fine sandy loam about 6 inches thick. The subsoil is pale brown very fine sandy loam and light yellowish brown gravelly very fine sandy loam about 24 inches thick. The substratum is extremely cobbly sand that extends to a depth of 60 inches or more. Depth to the extremely cobbly sand ranges from 20 to 40 inches. This soil contains much pumice and volcanic ash in the surface layer and subsoil.

Included with this soil in mapping are small areas of Cashmere; Chelan, gravelly substratum; and Quincy soils. Also included are small areas that have a gravelly or cobbly very fine sandy loam surface layer and several small areas that have slopes of 0 to 3 percent.

Permeability of this Supplee soil is moderate to a depth of about 30 inches and very rapid below that. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is slight. There is a high hazard of soil blowing. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

The main limitations for irrigated orchards are the slope and soil blowing.

To reduce soil blowing, care should be taken to not leave areas of soil unprotected. Perennial cover crops can reduce soil blowing in orchards. Cover crops improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 3.0 inches of water should be applied every 10 days at a rate of 0.5 inch per hour for sprinkler irrigation of mature orchards. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. If furrow irrigation systems are used, the furrows should be on the contour, or across the slope.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and

poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

This soil is well suited to homesites. It is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of ground water.

This soil is in capability subclass IIIe, irrigated.

72—Supplee very fine sandy loam, 8 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in loess, volcanic ash, and pumice over glacial outwash. Native vegetation is mainly grass and shrubs. Individual areas of this soil are irregular in shape and range in size from 3 to 250 acres. Elevation is 1,000 to 1,700 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 50 degrees F, and the frost-free season is 150 to 200 days.

Typically, the surface layer is light brownish gray very fine sandy loam about 6 inches thick. The subsoil is pale brown very fine sandy loam and light yellowish brown gravelly very fine sandy loam about 24 inches thick. The substratum is extremely cobbly sand that extends to a depth of 60 inches or more. Depth to the extremely cobbly sand ranges from 20 to 40 inches. This soil contains much pumice and volcanic ash in the surface and subsoil.

Included with this soil in mapping are small areas of Cashmere; Chelan, gravelly substratum; and Quincy soils. Also included are small areas that have a gravelly, cobbly, or stony very fine sandy loam surface layer and a few small areas that have slopes of 15 to 45 percent.

Permeability of this Supplee soil is moderate over the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Surface runoff is medium, and the water erosion hazard is moderate. There is a high hazard of soil blowing. The surface layer is very friable and easily tilled.

This soil is used mainly for irrigated orchards. Apple orchards predominate, but some pears, peaches, apricots, and cherries are also grown. Some areas are used for irrigated hay, pasture, and homesites.

The main limitations for irrigated croplands are the slope and soil blowing. To reduce soil blowing, care should be taken to not leave areas of soil unprotected.

Cover crops can reduce soil blowing in orchards. Cover crops improve fertility, reduce crusting, and increase water infiltration.

At the peak of the growing season, about 3.0 inches of water should be applied every 10 days at a rate of 0.5 inch per hour for sprinkler irrigation of mature orchards. Sprinklers are the most suitable method of irrigation. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.

Excessive grazing can destroy vegetation and cause surface compaction, resulting in increased runoff and poor tilth. Proper stocking, proper pasture management, pasture rotation, clipping, spreading of droppings, fertilizer, weed control, and restricted use during wet periods can help keep the pasture and soil in good condition.

Slope is the main limitation for homesites. This soil is a poor filter for septic tank absorption fields. The excessive permeability can result in pollution of ground water.

This soil is in capability subclass IVe, irrigated.

73—Timentwa loam, 0 to 15 percent slopes. This deep, well drained soil is on basalt plateaus. It formed in loess overlying glacial till. Native vegetation is mainly bunchgrass and sagebrush. Elevation is 2,400 to 2,600 feet. The average annual precipitation is 12 to 15 inches, mean annual air temperature is about 47 degrees F, and the frost-free season is 110 to 150 days.

Typically, the upper part of the surface layer is grayish brown loam about 10 inches thick. The lower part is brown gravelly loam about 8 inches thick. The subsoil is brown gravelly loam about 23 inches thick over a weakly cemented duripan at a depth of 41 inches. The substratum under the duripan is grayish brown very gravelly loam from a depth of 52 to 60 inches or more. Depth to weakly cemented duripan ranges from 40 to 55 inches.

Included with this soil in mapping are areas of Timentwa loam with slopes of more than 15 percent that make up about 5 percent of the unit. Also included are areas of Heytou soils on small knolls and ridges that make up 10 percent of the unit. Another 10 percent of the unit is made up of areas of Touhey soils and small areas of Aquolls, nearly level, and Haploxerolls, nearly level.

Permeability of this Timentwa soil is moderate. Available water capacity is moderate. Effective rooting depth is 40 to 55 inches. Surface runoff is medium, and the water erosion hazard is moderate.

This soil is used mainly for nonirrigated cropland (fig. 6) and wildlife habitat.

The main crop is winter wheat in a summer-fallow system. Precipitation is generally too low to support annual cropping. Erosion can be reduced on nonirrigated cropland if stubble mulch tillage is used, waterways are shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and winter wheat is seeded early.

This soil is in capability subclass IIIe, nonirrigated.

74—Touhey loam, 0 to 15 percent slopes. This very deep, well drained soil is on basalt plateaus. It formed in glacial till mixed with loess in the upper part. Native vegetation is mainly bunchgrass and sagebrush. Elevation is 1,500 to 3,000 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 49 degrees F, and the frost-free season is 135 to 165 days.

Figure 6.—Cropland on Timentwa loam, 0 to 15 percent slopes. Uncultivated area in center is Aquolls, nearly level.

Typically, the surface layer is brown loam 10 inches thick. The subsoil is yellowish brown gravelly loam 9 inches thick. The substratum is gray gravelly loam to a depth of 60 inches or more with discontinuous cemented lenses of lime and silica less than 1/8 inch thick at a depth of about 28 inches. Depth to the discontinuous cementation ranges from 20 to 36 inches.

Included with this soil in mapping are areas of Heytou soils that make up about 10 percent of the unit, Strat and Timentwa soils that make up 10 percent of the unit, and Touhey soils with slopes up to 30 percent, that make up 5 percent of the unit. Small areas of soils that are moderately well, somewhat poorly, and poorly drained are in depressions. Potholes are included. Also included are some small slick spots just east and south of the town of Mansfield. The Heytou soils are mostly on small knobs and ridges that occur throughout the area.

Permeability of this Touhey soil is moderate over the hardpan and moderately slow through it. Available water capacity is moderate. Effective rooting depth is restricted at a depth of 20 to 36 inches by the discontinuous cementation. Surface runoff is medium, and the water erosion hazard is moderate.

This soil is used mainly for nonirrigated cropland and wildlife habitat. A small amount is rangeland.

The main crop is winter wheat in a summer-fallow system. Precipitation is generally too low to support annual cropping. Erosion can be reduced on nonirrigated cropland if stubble mulch tillage is used, waterways are shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and winter wheat is seeded early.

The potential native vegetation is bluebunch wheatgrass, needleandthread, big sagebrush, and balsamroot.

Management of the vegetation for livestock grazing should be designed to increase production of the bluebunch wheatgrass and needleandthread. Brush management by aerial spraying or mechanical means can improve deteriorated range. If the range vegetation is seriously deteriorated, seeding is needed. The plants selected for seeding should be adapted species. For best results, the seedbed should be properly prepared and a grass drill used. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand the expected intensity of grazing. Management practices suitable for this soil include proper grazing, deferred grazing, rotation grazing, and water development.

This soil is in capability subclass IIIe, nonirrigated.

75—Willis silt loam, 3 to 15 percent slopes. This soil is moderately deep and well drained. It is on basalt plateaus. It formed in loess. Native vegetation is mainly bunchgrass and sagebrush. Elevation is 1,500 to 3,000 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 49 degrees F, and the frost-free season is 140 to 180 days.

Typically, the surface layer is brown silt loam 10 inches thick. The subsoil is pale brown silt loam 10 inches thick. The substratum is pale brown silt loam 8 inches thick over an indurated duripan at a depth of 28 inches. Depth to the duripan ranges from 20 to 40 inches.

Included with this soil in mapping are areas of Renslow soil that make up about 10 percent of the unit. The Renslow soil is mostly on lower side slopes. Also included are areas of Lickskillet and Zen soils that make up another 10 percent of the unit.

Permeability of this Willis soil is moderate above the hardpan. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of water erosion is moderate.

This soil is used mainly for nonirrigated cropland and wildlife habitat. A few areas are rangeland.

The main crop is winter wheat in a summer-fallow system. Precipitation is too low to support annual cropping. Erosion can be reduced on nonirrigated cropland if stubble mulch tillage is used, waterways are shaped and seeded to perennial grass, stubble fields are chiseled in the fall, and winter wheat is seeded early. The main limitation when constructing and maintaining the terraces, diversions, and grass waterways is the shallow depth to the duripan.

When used for rangeland, potential native vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, Thurber needlegrass, and big sagebrush.

Management of the vegetation should be designed to increase production of bluebunch wheatgrass and Idaho fescue. Brush management by aerial spraying or mechanical means can improve deteriorated range. If the range vegetation is seriously deteriorated, seeding is needed. The plants selected for seeding should be adapted species. For best results, the seedbed should be properly prepared and a grass drill used. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand the expected intensity of grazing. Management practices suitable for this soil include proper grazing use, deferred grazing, rotation grazing, and water development.

This soil is in capability subclass IIIe, nonirrigated.

76—Xerofluvents, nearly level. These very deep, well drained soils are on alluvial fans and flood plains. They formed in recent alluvium. Slope is 0 to 8 percent. Native vegetation is widely scattered grass and brush. Individual areas of this soil are commonly long and narrow in shape and range in size from 2 to about 100 acres. Elevation is 600 to 1,400 feet. The average annual precipitation is 8 to 10 inches, and the mean annual air temperature is about 51 degrees F.

No one pedon represents this map unit but one of the more common ones is highly stratified but dominantly extremely cobbly sand from 0 to 60 inches deep or more. The content of rock fragments varies widely within short distances.

Included with this unit in mapping are small areas of Beverly and Pogue soils.

Permeability of these Xerofluvents is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Surface runoff is slow, and the water erosion hazard is slight. The unit is subject to common flooding during the spring months.

This unit is used mainly for rangeland. Forage production is very low, and most areas are idle.

This unit is in capability subclass VIIs, nonirrigated.

77—Xerorthents, very steep. These very deep, somewhat excessively drained soils are on terrace escarpments. They formed in glacial outwash mixed with loess in the upper part. Slope is 25 to 65 percent. Native vegetation is mainly bunchgrass and sagebrush. Elevation is 600 to 1,800 feet. The average annual precipitation is 7 to 12 inches, mean annual air temperature is about 51 degrees F, and the frost-free season is 165 to 190 days.

Included with this unit in mapping are areas of Burbank, Magallon, Pogue, Quincy, Supplee, and Willis soils that make up as much as 10 percent of the unit. On the steep slopes immediately west of and lower than Fancher Air Field is an included soil with a cemented lime-silica hardpan at a depth of 12 to 30 inches.

No one pedon represents this map unit but in one of the more common ones the surface layer is a brown gravelly fine sandy loam 10 inches thick. The underlying material is very cobbly sand that extends to a depth of 60 inches or more. The surface layer ranges to sandy loam or gravelly sandy loam and the underlying material from very cobbly sand to extremely cobbly sand. Texture varies widely within short distances.

Permeability of these Xerorthents is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Surface runoff is very rapid, and the hazard of water erosion is very high.

This unit is used mainly for rangeland and wildlife habitat.

The potential native vegetation is bluebunch wheatgrass, needleandthread, balsamroot, and rabbitbrush. Management of the vegetation should be designed to increase production of bluebunch wheatgrass and needleandthread. Brush management by aerial spraying, proper grazing, deferred or rotation grazing, and needed water development can improve deteriorated range. Mechanical brush management is generally not practical because of the very steep slopes.

This unit is suited to wildlife habitat.

This unit is in capability subclass VIIe, nonirrigated.

78—Zen-Bakeoven-Lickskillet association, undulating. This unit is on broad basalt plateaus. The soils formed in loess and loess mixed with alluvium and colluvium from basalt. Slope is 0 to 25 percent. Native vegetation is mainly bunchgrass and sagebrush. Elevation is 1,500 to 3,200 feet. The average annual precipitation is 9 to 12 inches, mean annual air temperature is about 49 degrees F, and the frost-free season is 140 to 180 days.

This unit is about 35 percent Zen silt loam, 0 to 15 percent slopes; 35 percent Bakeoven very cobbly loam, 3 to 25 percent slopes; and 15 percent Lickskillet cobbly silt loam, 3 to 25 percent slopes. The Zen soil is in biscuitlike mounds and long narrow stringers. The Bakeoven soil is near canyon rims and at the heads of drainageways. The Lickskillet soil lies between the Zen and Bakeoven soils.

Included with this unit in mapping are areas of Broadax, Kiona, Ralls, Renslow, Strat, and Willis soils and some small areas of Rock outcrop and Rubble land. These included areas make up as much as 15 percent of the unit.

The Zen soil is moderately deep and well drained. It formed in loess. Typically, it has a brown and dark brown silt loam surface layer about 18 inches thick. The subsoil is yellowish brown and light yellowish brown heavy silt loam 16 inches thick. Basalt is at a depth of about 34 inches. Depth to the basalt ranges from 20 to 40 inches.

Permeability of the Zen soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the hazard of water erosion is moderate.

The Bakeoven soil is shallow and well drained. It formed in weathered basalt colluvium and alluvium mixed with loess. Typically, it has a brown, very cobbly loam surface layer about 4 inches thick. The subsoil is yellowish brown very gravelly loam and clay loam about 5 inches thick over basalt. Basalt is at a depth of about 9 inches. Depth to the basalt ranges from 4 to 12 inches.

Permeability of the Bakeoven soil is moderately slow. Available water capacity is low. Effective rooting depth is 4 to 12 inches. Surface runoff is medium, and the hazard of water erosion is moderate.

The Lickskillet soil is shallow and well drained. It formed in weathered basalt mixed with loess and colluvium. Typically, the surface layer is brown cobbly silt loam 4 inches thick. The subsoil is brown gravelly loam and yellowish brown very gravelly heavy silt loam 14 inches thick over basalt. Basalt is at a depth of 18 inches. Depth to the basalt ranges from 12 to 20 inches.

Permeability of the Lickskillet soil is moderate. Available water capacity is low. Effective rooting depth is 12 to 20 inches. Surface runoff is medium, and the hazard of water erosion is moderate.

This unit is used mainly for rangeland and wildlife habitat.

The main limitations for rangeland are the shallow rooting depth and surface cobbles on the Bakeoven and Lickskillet soils.

The potential native vegetation on Zen soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and sagebrush. The potential native vegetation on Bakeoven soil is mainly Sandberg bluegrass and stiff sagebrush. On Lickskillet soil it is mainly bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and stiff sagebrush.

Management of the vegetation on the Zen soil should be designed to increase production of bluebunch wheatgrass. Brush management by aerial spraying or mechanical means can improve deteriorated range. If the range vegetation is seriously deteriorated, seeding is needed. The plants selected for seeding should be adapted species. For best results, the seedbed should be properly prepared and a grass drill used. Grazing should be delayed until the desirable forage plants have achieved sufficient growth to withstand the expected intensity of grazing. Management practices suitable for this soil include proper grazing, deferred grazing, rotation grazing, and water development.

Management of vegetation should be designed to increase production of bluebunch wheatgrass on the Lickskillet soil and maintain the stand of Sandberg bluegrass on the Bakeoven soil. Proper grazing management can improve deteriorated range. Management practices suitable for these soils are proper range use, deferred grazing, rotation grazing, and aerial spraying for brush management.

The Zen soil is in capability subclass IIIe, nonirrigated; the Bakeoven soil is in VIIs, nonirrigated; and the Lickskillet soil is in VIIs, nonirrigated.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Each field or farm is a geographical area with a unique combination of soils, slopes, elevation, climate, and other natural resources. Cropland and pasture management should consist of a system of treatments that recognize these resources—

- Management to enhance the environment may include developing watering facilities, planting hedgerows, leaving some grain standing, or establishing odd areas in permanent cover to encourage wildlife; following pesticide labels and proper disposal of empty pesticide containers; and trapping sediment in debris basins and proper disposal of animal wastes.
- Management to increase income, reduce expenses, or conserve energy may include waste utilization, artificial drainage, toxic salt reduction, fertilization, and weed control.
- Management to protect the soil from erosion may include using a suitable crop rotation that may or may not include cover crops, green manure crops, or grasses and legumes; stubble mulching, early fall seeding; divided slope farming, terraces, fall chiseling, field windbreaks, and grassed waterways.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 8. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered. The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown and that good quality irrigation water is uniformly applied as needed.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely

to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 8 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (*10*). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

rangeland

Lawrence P. Lilley, area range conservationist, Soil Conservation Service, helped prepare this section.

About 49 percent of the land in Douglas County, or 570,000 acres, is rangeland. In 1974 there were 16,954 head of cattle in the county. This is about 1 percent of the cattle in the state.

Most cattle operations in Douglas County have spring and summer ranges in the major uninterpreted rangelands on Badger Mountain and along the steep breaks of the Columbia River, Douglas Creek, Moses Coulee, and the Grand Coulee. There are also large range tracts in the Foster Creek, Del Rio, and Rex areas. Small range and pasture areas are intermingled with wheatland throughout the county.

Some ranchers graze their cattle on Federal lands in the surrounding counties of Okanogan, Chelan, and Kittitas. Permits to use these areas are issued by the USDA Forest Service.

Fall and winter operations vary, depending on the size of the unit. Most ranchers winter their livestock by feeding hay; a few move their operations south to counties such as Grant to take advantage of crop stubble and feedlot operations. Units average about 1,091 acres in size.

Most of the Idaho fescue has been all but grazed out except on the higher northern slopes. Soil depths greatly determine the amount of vegetation available, ranging from 200 pounds of forage per acre per year on the very shallow soils to 2,000 or more on the higher producing loamy soils on Badger Mountain.

Grazing systems that are suited to most areas of the county and that benefit both livestock and wildlife are systems that defer the grazing or at least give the grass a rest every second or third year. Planned grazing systems are well suited to all soils in Douglas County. Proper grazing practices in the county are usually designed for bluebunch wheatgrass or Idaho fescue except on bottomland and alkali range sites. Grazing should utilize about half of the annual growth of

bluebunch wheatgrass and Idaho fescue. In a normal growing season, this will leave a stubble height of about 4 to 6 inches.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils, vegetation, and water.

Table 9 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are suited to rangeland are listed. Explanation of the column headings in table 9 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients influence the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that grows annually. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plant community growing on a site will be maintained or improved. Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing and browsing needs, provides wildlife habitat, and protects soil and water resources.

Important range improvement practices on all rangeland in the survey area are proper grazing use and planned grazing systems. Distribution of grazing, which is also an important management practice, can be accomplished with proper placement of watering facilities and salting, combined with fencing and herding. The suitability of range practices such as brush management, range seeding, and water development depends on the characteristics of the site.

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made generally on field boundaries at right angles to the prevailing wind. Additional rows may also be installed at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 10 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 10 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Not all of the soils in the county are listed in table 10. The soils not listed generally are not irrigated, receive less than 12 inches of precipitation per year, or are too droughty for windbreak establishment and survival. Irrigation can make a few of these soils more suitable for windbreaks. Contact the local soil conservation district

for predicted heights of windbreak species on these soils.

recreation

The soils of the survey area are rated in table 11 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 11, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 11 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 14 and interpretations for dwellings without basements and for local roads and streets in table 13.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

Ivan L. Lines, Jr., biologist, Soil Conservation Service, helped prepare this section.

Prior to the late 1870's, most of Douglas County supported prairie-type vegetation. Extensive grasslands were interspersed by numerous small streams that were bordered by shrubby vegetation. This was good habitat for coyotes, bobcats, wolves, sage grouse, sharp-tailed grouse, rabbits, doves, and numerous other small birds and mammals. Streams such as Foster Creek and Douglas Creek were perennially clear and contained many fish. Beaver were common along the streams.

The steep, rocky breaks of the Columbia River were inhabitated by mule deer, yellow-bellied marmot, and rattlesnakes. The woodland on Badger Mountain provided habitat for forest wildlife such as mule deer, bobcat, and ruffed and blue grouse. The rangelands in the northeastern part of the county are pock-marked with numerous natural potholes that were choice nesting and brood-rearing areas for waterfowl.

Since the 1870's, much of the prairie has been put under cultivation and the remainder grazed, often severely, by livestock. Only remnant populations of sage and sharp-tailed grouse and mule deer remain in cultivated areas. Introduced species such as ring-necked pheasant and gray partridge, although once fairly abundant, have also declined in cropland areas where there is very little vegetation other than wheat.

A number of years ago, California quail and chukar partridge were introduced to the breaks and riparian vegetation along the Columbia River. While chukars continue to flourish on the steep, rocky breaks, most of the riparian vegetation of value to quail and mourning doves has been inundated by reservoirs developed on the Columbia River or replaced by orchards.

Most of the pothole wetlands remain. The surrounding upland vegetation necessary for waterfowl nesting, however, has been eliminated by cultivation or disturbed by overgrazing. The reservoirs on the Columbia River now provide a large resting area for migrating waterfowl, which feed heavily on waste grain in the adjoining croplands.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

wildlife on the general soil map units

1—Pogue-Quincy-Xerorthents, very steep. In their native condition, the soils in this unit provide habitat for mule deer, coyotes, yellow-bellied marmot, rattlesnakes, and other types of rangeland wildlife. The development of irrigated agriculture in the lower areas has provided additional food and cover for wildlife such as mourning doves, the introduced chukar and gray partridge, and California quail. In many areas, orchards have replaced the traditional winter ranges of deer.

Wildlife benefit from proper livestick grazing on both rangeland and irrigated pasture. Wooded drainageways provide valuable food and cover for many species and should be protected from excessive grazing and other disturbances. The development of springs, seeps, and small ponds increases the wildlife carrying capacity of the soils and provides water for livestock. Wildlife can benefit from the maintenance of abundant plant cover to prevent erosion and judicious use of pesticides on irrigated lands.

2—Bakeoven-Rock Creek-Lickskillet. The vegetation on the soils in this unit provides habitat for mule deer, coyotes, yellow-bellied marmot, rattlesnakes, and other rangeland wildlife. These soils also provide good habitat for pheasant, chukar and gray partridge, California quail, and mourning doves, especially where bordered by or interspersed with cropland.

Wildlife thrive in areas with abundant plant cover and rich, wooded plant diversity, especially in natural drainageways. Native plant communities can be maintained by proper livestock grazing and protecting the range from catastrophic range fires. Both wildlife and livestock benefit from the development of springs, seeps, and ponds for drinking water.

3—Dinkels-Cordy. The soils in this unit provide summer range for mule deer, as well as ruffed and blue grouse, bobcats, and numerous nongame birds and mammals. The interspersion of coniferous trees in open areas containing an abundance of shrubby and herbaceous vegetation provides a good mix of food and cover for woodland wildlife.

Proper livestock grazing helps maintain a diverse and abundant plant community for wildlife food and cover. Logging of small areas frequently creates better wildlife habitat by creating a better mix of forest and open areas. Tree snags should be maintained for the numerous cavity-nesting birds. The development of drinking water improves the carrying capacity for wildlife.

4—Renslow-Zen. In their native condition, the soils in this unit provided habitat for rangeland wildlife such as mule deer, coyotes, and sage grouse. Much of the area has been converted to nonirrigated cropland, which provides food for mourning doves, gray partridge, pheasant, and wintering waterfowl.

These soils are largely devoid of the cover required by upland game birds. These birds mostly use areas where cropland is bordered or interspersed with native rangeland, roadside cover, or wooded or herbaceous drainages. They can benefit from additional cover created by grassed waterways, minimum tillage, windbreaks, or permanently vegetated terraces. The development of wildlife drinking water improves the distribution and abundance of wildlife.

5—Touhey-Heytou. Native vegetation on the soils in this unit provided habitat for rangeland types of wildlife such as mule deer, coyotes, sharp-tailed and sage grouse, and jackrabbits. Numerous natural wetlands provide habitat for ducks, geese, shore birds, muskrats, and other wetland wildlife. Much of the native vegetation has been replaced by a wheat-fallow crop rotation that provides little permanent cover for wildlife. Cropland does provide food for most upland game birds where it is interspersed with or bordered by native rangeland or other cover. It provides food for waterfowl where it is adjacent or near wetlands or open water.

The habitat can be improved for most small birds and mammals by creating permanent cover along roadsides, along fence lines, in grassed waterways, on terraces, in windbreaks, and adjacent to natural drainageways and wetlands. Riparian vegetation provides critical cover, particularly in winter, for many animals. Wildlife drinking water is not available in many areas. Waterfowl nesting habitat can be improved by leaving undisturbed the upland nesting cover adjacent to streams, lakes, and ponds.

6—Willis. The native grass-shrub vegetation in the soils in this unit provided habitat for mule deer, coyotes, sage grouse, jackrabbits, and other rangeland wildlife. Much of the native vegetation has been replaced, however, by nonirrigated cropland that provides little permanent cover for native wildlife. Cropland provides more food for upland game where it is bordered by permanent cover. It provides more food for waterfowl where it is near wetlands or open water.

The habitat can be improved for most small birds and mammals by planting windbreaks and by creating or retaining permanent cover along roadsides, along fence lines, along manmade and natural waterways, and on terraces. Wildlife drinking water is not available in many areas.

7—Bakeoven-Touhey. The native herbaceous and shrubby vegetation on the soils in this unit provides habitat for mule deer, sage grouse, jackrabbits, coyotes, and other rangeland wildlife. Numerous depressions and potholes provide habitat for ducks, geese, shore birds, muskrats, and other wetland wildlife. Upland game birds such as chukar and gray partridges, pheasant, California quail, and mourning doves utilize the permanent cover on these soils, especially where bordered by or interspersed with croplands.

Proper livestock grazing helps maintain a diverse and abundant plant community that provides food and cover for wildlife. The maintenance of cover around wetlands and along streams is especially important for wildlife. In many areas, wildlife benefit from the development of permanent sources of drinking water. Brush control projects should be carefully planned to consider the needs of wildlife.

wildlife on the detailed soil map units

In table 12, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are tall wheatgrass, intermediate wheatgrass, crested wheatgrass, Sherman big bluegrass, sweet clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluebunch wheatgrass, Idaho fescue, needleandthread, cheatgrass, balsamroot, lupine, and wild buckwheat.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are ponderosa pine, Douglas-fir, snowberry, pinegrass, serviceberry, and native rose.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are bitterbrush, snowberry, big sagebrush, threetip sagebrush, rabbitbrush, chokeberry, redosier dogwood, serviceberry, and native rose.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are cattails, bulrushes, wild millet, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include California quail, pheasant, meadowlark, gray partridge, horned lark, ravens, cottontail rabbits, and prairie falcon.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, blue grouse, thrushes, woodpeckers, deer, and bobcat.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include mule deer, sage grouse, sharp-tailed grouse, chukars, doves, woodchucks, rattlesnakes, meadowlark, snow bunting, lapland longspur, and peregrine falcon.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 13 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to

bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 14 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 14 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 14 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive

or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 14 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excessive gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 15 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 15, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, the water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 16 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across

a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 17 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material (*6*). Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 18 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area.

The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume (*3*). Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil (*3*). The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided

calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 18, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Tables 19 and 20 give estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

In table 19 *Hydrologic soil groups* are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 19 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 19 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 19.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water

stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone. Only saturated zones within a depth of about 6 feet are indicated.

In table 20 *Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*11*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 21, the soils of the survey area are classified according to the system (*4*). The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Xeroll (*Xer*, meaning dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argixerolls (*Argi*, meaning maximal horizonation, plus *Xeroll*, the suborder of the Mollisols that have a dry moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argixerolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is loamy-skeletal, mixed, mesic Typic Argixerolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*8*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*11*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

Badge series

The Badge series consists of very deep, well drained soils on the sides of canyons and in drainageways. These soils formed in colluvium mixed with loess. Slope ranges from 25 to 65 percent. Elevation is 3,000 to 4,000 feet. The average annual precipitation is 12 to 14 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Badge very cobbly silt loam, 25 to 65 percent slopes (fig. 7), near the center of sec. 5, T. 23 N., R. 22 E.

Figure 7.—Profile of Badge very cobbly silt loam, 25 to 65 percent slopes. The subsoil is extremely cobbly clay loam at a depth of 13 to 28 inches.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) very cobbly silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable, nonsticky and slightly plastic; many fine roots; many fine and medium tubular pores; 50 percent basalt rock fragments, mainly cobbles; neutral; gradual smooth boundary.

A12—8 to 13 inches; brown (10YR 5/3) very gravelly heavy silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, firm, slightly sticky and plastic; common fine roots; few fine tubular pores; 35 percent basalt rock fragments, mainly pebbles; neutral; clear smooth boundary.

B2t—13 to 28 inches; yellowish brown (10YR 5/4) extremely cobbly clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; few medium tubular pores; 75 percent basalt rock fragments; neutral; gradual smooth boundary.

C—28 to 60 inches; light yellowish brown (10YR 6/4) very cobbly heavy silt loam, dark brown (10YR 4/3) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; few fine roots; few fine tubular pores; 60 percent basalt rock fragments; mildly alkaline.

The control section ranges from 35 to 75 percent rock fragments.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist and chroma of 2 or 3 when dry or moist.

When dry, the B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. Chroma is 2 to 4 when moist.

The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 when dry, and chroma of 2 or 3 when moist. It has white mycelial lime segregations in some pedons. The pebbles and cobbles commonly have white coatings of lime and silica on the undersides. The C horizon is very cobbly silt loam or clay loam.

Bakeoven series

The Bakeoven series consists of shallow, well drained soils on basalt plateaus. These soils formed in basalt colluvium and alluvium mixed with loess. Slope ranges from 3 to 25 percent. Elevation is 1,000 to 3,200 feet. The average annual precipitation is 7 to 12 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of a Bakeoven very cobbly loam, in an area of Zen-Bakeoven-Lickskillet association, undulating, 680 feet southwest of the east 1/4 corner of sec. 10, T. 20 N., R. 22 E.

A1—0 to 4 inches; brown (10YR 5/3) very cobbly loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine and medium tubular pores; 25 percent cobbles, 20 percent pebbles, many cobbles on the surface; mildly alkaline; clear smooth boundary.

B1—4 to 7 inches; yellowish brown (10YR 5/4) very gravelly loam, dark brown (10YR 3/3) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; few very fine tubular pores; 35 percent pebbles, 5 percent cobbles; mildly alkaline; clear smooth boundary.

B2—7 to 9 inches; yellowish brown (10YR 5/4) very gravelly clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky

structure; hard, friable, sticky and plastic, common fine roots; few very fine tubular pores; 35 percent pebbles, 5 percent cobbles; mildly alkaline; abrupt wavy boundary.
IIR—9 inches; basalt.

Thickness of solum and depth to bedrock range from 4 to 12 inches. The control section ranges from 35 to 75 percent rock fragments.

The A horizon has value of 4 or 5 when dry and chroma of 3 or 4 when dry and 2 or 3 when moist. It ranges from slightly acid to mildly alkaline.

The B horizon has hue of 10YR or 7.5YR. It has value of 3 to 5 when dry and 3 or 4 when moist. Chroma is 3 or 4 when dry and moist. Texture is very gravelly loam, very gravelly clay loam, or very gravelly silt loam. The B horizon is neutral or mildly alkaline.

Beverly series

The Beverly series consists of very deep, somewhat excessively drained soils on low terraces and fans. These soils formed in recent alluvium. Slope is 0 to 8 percent. Elevation is 600 to 2,400 feet. The average annual precipitation is 8 to 12 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of Beverly cobbly fine sandy loam, 0 to 8 percent slopes, 1,320 feet north and 400 feet west of the southeast corner of sec. 29, T. 25 N., R. 21 E.

Ap—0 to 5 inches; grayish brown (10YR 5/2) cobbly fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; few fine tubular pores; 15 percent cobbles and 5 percent pebbles; mildly alkaline; clear smooth boundary.
C1—5 to 14 inches; stratified light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) gravelly fine sandy loam, dark brown (10YR 3/3) and very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; 15 percent pebbles and 5 percent cobbles; mildly alkaline; clear smooth boundary.
C2—14 to 20 inches; pale brown (10YR 6/3) very gravelly sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; very few fine tubular pores; 35 percent pebbles and 15 percent cobbles; few thin grayish brown (10YR 5/2), very dark grayish brown (10YR 3/2 moist) strata; mildly alkaline; gradual wavy boundary.
IIC3—20 to 60 inches; multicolored extremely gravelly loamy coarse sand; single grain; loose; 70 percent pebbles, 10 percent cobbles, 5 percent stones; mildly alkaline.

The control section averages more than 35 percent rock fragments. Reaction is neutral or mildly alkaline throughout. Depth to the IIC horizon ranges from 14 to 25 inches.

The A horizon has value of 4 or 5 when dry and chroma of 2 to 4 when dry or moist.

The C horizon has value of 4 to 6 when dry and 2 to 4 when moist. It has chroma of 2 to 4 when moist and dry. The C horizon is stratified sandy loam, fine sandy loam, or loamy sand. It is gravelly or very gravelly.

The IIC horizon varies widely in color. Texture is sand, loamy sand, or loamy coarse sand. This horizon is extremely gravelly.

Broadax series

The Broadax series consists of very deep, well drained soils on basalt plateaus. These soils formed in loess. Slope ranges from 0 to 15 percent. Elevation is 2,400 to 4,000 feet. The average annual precipitation is 12 to 15 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of a Broadax silt loam, in an area of Broadax-Condon association, rolling, 1,320 feet south of the northeast corner of sec. 3, T. 23 N., R. 22 E.

A1—0 to 13 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky and slightly plastic; many fine roots; common medium and fine pores; mildly alkaline; clear smooth boundary.
B2t—13 to 26 inches; pale brown (10YR 6/3) silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium prismatic structure; very hard, very firm, sticky and plastic; few fine roots; many fine and medium pores; few thin clay films on ped faces; mildly alkaline; clear smooth boundary.
B3tca—26 to 35 inches; yellowish brown (10YR 5/4) heavy silt loam, dark brown (10YR 4/3) moist; weak medium and coarse prismatic structure; hard, firm, slightly sticky and slightly plastic; few fine roots; common fine and medium pores; moderately effervescent; moderately alkaline; gradual wavy boundary.
Cca—35 to 60 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; massive; hard, firm, nonsticky and slightly plastic; very few fine roots; common large and medium pores; violently effervescent; strongly alkaline.

The A horizon has value of 4 or 5 when dry, value of 2 or 3 when moist, and chroma of 2 or 3 when dry or moist. Structure is moderate or weak granular or platy.

The B2 horizon has value of 5 or 6 when dry and 3 or 4 when moist and chroma of 2 to 4 when dry or moist. It is heavy silt loam or silty clay loam. Content of clay ranges from 20 to 35 percent. The horizon is less than

15 percent fine sand or coarser. Secondary carbonates are in pores, in root channels, or in the matrix at a depth of 26 to 40 inches. Structure is moderate or weak prismatic.

The C horizon has value of 5 or 6 when dry, value of 3 or 4 when moist, and chroma of 3 or 4 when dry or moist. It has secondary carbonates and is moderately or strongly alkaline.

Burbank series

The Burbank series consists of very deep, excessively drained soils on low terraces. These soils formed in a mixture of wind-deposited sand and alluvial sand over glacial outwash gravel. Slope ranges from 0 to 25 percent. Elevation is 600 to 1,000 feet. The average annual precipitation is 7 to 9 inches, and the mean annual air temperature is about 51 degrees F.

Typical pedon of Burbank loamy fine sand, 0 to 8 percent slopes, 1,320 feet east and 1,320 feet south of the northwest corner of sec. 11, T. 23 N., R. 20 E.

Ap—0 to 6 inches; yellowish brown (10YR 5/4) loamy fine sand, dark brown (10YR 3/3) moist; weak medium crumb structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; few fine tubular pores; 10 percent gravel; mildly alkaline; gradual smooth boundary.

C1—6 to 20 inches; yellowish brown (10YR 5/4) gravelly loamy fine sand, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; 20 percent pebbles, 5 percent cobbles; mildly alkaline; abrupt wavy boundary.

C2—20 to 60 inches; multicolored extremely cobbly coarse sand; single grain; loose; 30 percent cobbles, 30 percent pebbles, few stones; mildly alkaline.

The control section averages 45 to 80 percent coarse fragments. It is mildly alkaline or moderately alkaline.

The A horizon has value of 5 or 6 when dry. It has chroma of 2 to 4 when dry and 2 or 3 when moist.

The upper part of the C horizon has value of 5 or 6 when dry and 3 or 4 when moist. It has chroma of 2 to 4 when dry and 3 or 4 when moist. Texture is loamy sand or loamy fine sand. The horizon is gravelly or cobbly in some places. The lower part of the C horizon is 30 to 45 percent gravel and 20 to 35 percent cobbles. There are a few stones and boulders.

Burch series

The Burch series consists of very deep, well drained soils on terraces. These soils formed in alluvium mixed with loess. Slope ranges from 0 to 15 percent. Elevation is 700 to 1,200 feet. The average annual precipitation is 8 to 10 inches, and the mean annual air temperature is about 51 degrees F.

Typical pedon of Burch loam, 3 to 8 percent slopes, 1,000 feet southwest of the E1/4 corner of sec. 13, T. 22 N., R. 21 E.

Ap—0 to 10 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; few very fine tubular pores; neutral; clear smooth boundary.

B21—10 to 20 inches; yellowish brown (10YR 5/4) loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots; common fine and very fine tubular pores; neutral; gradual smooth boundary.

B22—20 to 30 inches; light brownish gray (10YR 6/2) loam, dark yellowish brown (10YR 3/4) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few fine roots; few medium tubular pores; mildly alkaline; gradual smooth boundary.

C—30 to 60 inches; pale brown (10YR 6/3) loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; few medium tubular pores; mildly alkaline.

The 10- to 40-inch control section is dominantly loam. It has thin stratifications of silt loam or very fine sandy loam. The content of coarse fragments is less than 5 percent.

The A horizon has chroma of 1 to 3 when dry and 2 or 3 when moist. It has value of 2 or 3 when moist.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist. It has chroma of 2 to 4 when dry and moist. Texture is loam or silt loam.

The C horizon has value of 5 to 7 and chroma of 2 to 4 when dry. Texture is dominantly loam.

Cashmere series

The Cashmere series consists of very deep, well drained soils on terraces. These soils formed in alluvium mixed with loess. Slope ranges from 0 to 15 percent. Elevation is 650 to 1,500 feet. The average annual precipitation is 8 to 10 inches, and the mean annual air temperature is about 51 degrees F.

Typical pedon of Cashmere fine sandy loam, 3 to 8 percent slopes, 100 feet east of the northwest corner of sec. 17, T. 22 N., R. 21 E.

Ap—0 to 4 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine and medium granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; very few fine tubular pores; mildly alkaline; clear smooth boundary.

A12—4 to 11 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak medium

granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; mildly alkaline; clear smooth boundary.

B2—11 to 24 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine prismatic structure; soft, very friable, nonsticky and nonplastic; common fine roots; very few very fine tubular pores; mildly alkaline; gradual wavy boundary.

C—24 to 60 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; very few very fine tubular pores; 2 percent pebbles; mildly alkaline.

The profile averages 0 to 10 percent coarse fragments.

The A horizon has chroma of 2 or 3 when dry or moist.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist. Texture is fine sandy loam or very fine sandy loam.

The C horizon has value of 6 to 8 when dry and 4 to 6 when moist. It has chroma of 2 to 4 when dry and moist.

Cashmont series

The Cashmont series consists of very deep, well drained soils on fans and terraces. These soils formed in alluvium mixed with loess. Slope ranges from 3 to 15 percent. Elevation is 700 to 1,800 feet. The average annual precipitation is 8 to 10 inches, and the mean annual air temperature is about 51 degrees F.

Typical pedon of Cashmont gravelly sandy loam, 8 to 15 percent slopes, 1,700 feet north of the S1/4 corner of sec. 21, T. 25 N., R. 17 E.

Ap—0 to 8 inches; dark gray (10YR 4/1) gravelly sandy loam, black (10YR 2/1) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; few fine tubular pores; 20 percent pebbles; mildly alkaline; clear wavy boundary.

A12—8 to 21 inches; dark gray (10YR 4/1) gravelly sandy loam, black (10YR 2/1) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; few fine tubular pores; 20 percent pebbles; mildly alkaline; clear wavy boundary.

B2—21 to 28 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; common fine tubular pores; 15 percent pebbles; mildly alkaline; gradual wavy boundary.

C—28 to 60 inches; pale brown (10YR 6/3) gravelly sandy loam, dark brown (10YR 4/3) moist; moderate medium granular structure; soft, very friable, nonsticky and nonplastic; few fine roots; common fine tubular pores; 20 percent pebbles; mildly alkaline.

The 10- to 40-inch control section has 15 to 35 percent coarse fragments.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It has chroma of 1 or 2 when dry and moist. The darker soils are those that have been irrigated for a long time. Texture of the A horizon is sandy loam or gravelly sandy loam.

The B horizon has value of 5 or 6 when dry. Chroma is 3 or 4 when moist. Texture is gravelly fine sandy loam or gravelly sandy loam.

The C horizon has value of 6 or 7 when dry and 4 or 5 when moist. It has chroma of 3 or 4 when dry and moist. Texture is gravelly fine sandy loam or gravelly sandy loam. A few pedons are gravelly or very gravelly loamy sand below a depth of 50 inches.

Cashmont Variant

The Cashmont Variant consists of very deep, well drained soils on terraces. These soils formed in alluvium mixed with loess in the surface. Slopes range from 3 to 15 percent. Elevation is 800 to 1,200 feet. The average annual precipitation is 8 to 10 inches, and the mean annual air temperature is about 51 degrees F.

Typical pedon of Cashmont Variant fine sandy loam, 3 to 8 percent slopes, 1,320 feet southeast of the northwest corner of sec. 20, T. 22 N., R. 21 E.

A1—0 to 12 inches; brown (10YR 5/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; few very fine tubular pores; 5 percent pebbles; neutral; clear smooth boundary.

B2—12 to 20 inches; pale brown (10YR 6/3) loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; 5 percent pebbles; neutral; clear wavy boundary.

IIC1—20 to 26 inches; light yellowish brown (10YR 6/4) very gravelly loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; common fine roots; many very fine tubular pores; 50 percent pebbles; neutral; clear wavy boundary.

IIC2—26 to 60 inches; very pale brown (10YR 7/3) extremely gravelly loam, yellowish brown (10YR 5/4) moist; massive; hard, firm, nonsticky and nonplastic; few fine roots; few fine tubular pores; 60 percent pebbles, 5 percent cobbles; moderately alkaline.

Depth to the IIC1 horizon ranges from 17 to 25 inches. The profile is neutral to moderately alkaline. The pH value increases with depth.

The A horizon has chroma of 2 or 3 when dry or moist. It is 5 to 10 percent gravel.

The B horizons have value of 5 or 6 when dry and chroma of 3 or 4 when dry or moist. Texture is loam or fine sandy loam. The horizon is 5 to 15 percent gravel.

The IIC horizon has value of 6 or 7 when dry and chroma of 3 or 4 when dry or moist. They range from 40 to 75 percent gravel and contain a few cobbles in some pedons. A white coating of lime and silica is on the undersides of most of the gravel.

Chelan series

The Chelan series consists of very deep, well drained soils on terraces and side slopes. These soils formed in loess, volcanic ash, and pumice over glacial drift. Slope is 0 to 65 percent. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 9 to 12 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of a Chelan bouldery very fine sandy loam, in an area of Chelan association, bouldery, 1,200 feet southwest of the center of sec. 15, T. 27 N., R. 21 E.

Ap—0 to 10 inches; light brownish gray (10YR 6/2) bouldery very fine sandy loam, dark brown (10YR 3/3) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; common fine and medium roots; few fine tubular pores; 10 percent pumice pebbles, 2 percent boulders on the surface; mildly alkaline; clear smooth boundary.

B2—10 to 25 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark brown (10YR 3/3) moist; weak medium prismatic structure; soft, very friable, nonsticky and nonplastic; few fine and medium roots; few very fine tubular pores; 5 percent pumice pebbles; mildly alkaline; abrupt smooth boundary.

C1—25 to 46 inches; yellowish brown (10YR 5/4) very fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few fine and medium roots; few very fine tubular pores; 10 percent pumice pebbles; mildly alkaline; abrupt wavy boundary.

IIC2—46 to 60 inches; light gray (10YR 7/1) very cobbly sandy loam, grayish brown (10YR 5/2) moist; massive; hard, firm, nonsticky and nonplastic; few fine tubular pores; 15 percent pebbles, 25 percent cobbles, 5 percent stones; strongly effervescent, strongly alkaline.

Content of pumice ranges from 5 to 30 percent above the IIC horizon. Depth to the IIC horizon is 40 to 60 inches.

The A horizon has hue of 10YR or 2.5Y, value of 6 or 7 when dry and 2 or 3 when moist, and chroma of 1 to 3 when dry or moist. It is neutral or mildly alkaline. Content of boulders in and on the surface ranges from 0 to 10 percent. Texture of the A horizon ranges from very fine sandy loam to bouldery very fine sandy loam.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6 when dry, and chroma of 1 to 4 when dry or moist. Texture is very fine sandy loam, fine sandy loam, or loam. The B horizon is neutral or mildly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 4 to 7 when dry or moist, and chroma of 2 to 4 when dry or moist. Texture is very fine sandy loam, sandy loam, or fine sandy loam. The C horizon is neutral or mildly alkaline.

The IIC horizon is variable. Texture ranges from gravelly loam to extremely cobbly sand. Reaction ranges from mildly alkaline to strongly alkaline.

Condon series

The Condon series consists of moderately deep, well drained soils on basalt plateaus. These soils formed in loess. Slope ranges from 0 to 15 percent. Elevation is 2,400 to 4,000 feet. The average annual precipitation is 12 to 15 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of a Condon silt loam in an area of Broadax-Condon association, rolling, 1,250 feet south of the northwest corner of sec. 3, T. 23 N., R. 22 E.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky and slightly plastic; many fine roots; many fine tubular pores; neutral; clear smooth boundary.

B21—7 to 13 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and slightly plastic; common fine roots; common fine pores; neutral; gradual smooth boundary.

B22—13 to 24 inches; brown (10YR 5/3) heavy silt loam, dark brown (10YR 3/2) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine and medium tubular pores; mildly alkaline; gradual smooth boundary.

B3—24 to 34 inches; pale brown (10YR 6/3) heavy silt loam, dark brown (10YR 4/2) moist; weak coarse prismatic structure; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine and medium tubular pores; mildly alkaline; abrupt wavy boundary.

IIR—34 inches; basalt.

The profile is neutral or mildly alkaline. Depth to basalt ranges from 20 to 40 inches.

The A horizon has chroma of 2 or 3 when dry and value of 2 or 3 when moist.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist. It has chroma of 2 to 4 when dry and 2 or 3 when moist.

Some pedons have a C horizon above the basalt.

Cordy series

The Cordy series consists of very deep, well drained soils on mountainsides. These soils formed in loess mixed with volcanic ash. Slope ranges from 3 to 55 percent. Elevation is 3,000 to 4,200 feet. The average annual precipitation is 12 to 15 inches, and the mean annual air temperature is about 44 degrees F.

Typical pedon of a Cordy loam in an area of Cordy association, steep, 1,000 feet south of the E1/4 corner of sec. 7, T. 24 N., R. 22 E.

O1—1/2 inch to 0; pine and fir needles, dead grass, and twigs.
A1—0 to 12 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; moderate coarse granular structure; soft, friable, nonsticky and slightly plastic; many fine, medium, and coarse roots; few fine tubular pores; neutral; clear wavy boundary.
B21—12 to 22 inches; yellowish brown (10YR 5/4) loam, dark brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, nonsticky and slightly plastic; many fine, medium, and coarse roots; few fine tubular pores; neutral; gradual wavy boundary.
B22—22 to 40 inches; brown (10YR 5/3) silt loam, dark yellowish brown (10YR 3/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common medium and coarse roots; common very fine and fine tubular pores; neutral; gradual smooth boundary.
C—40 to 60 inches; yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine, medium, and coarse roots; many very fine and fine tubular pores; neutral.

The profile is about 10 percent volcanic ash and is less than 10 percent rock fragments. Reaction is neutral or slightly acid.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It has chroma of 2 or 3 when dry or moist.

The B horizon has value of 4 or 5 when dry and 3 or 4 when moist. It has chroma of 3 or 4 when dry or moist. Texture is loam or silt loam. Structure of the B22 horizon is weak medium subangular blocky or prismatic.

The C horizon has value of 4 or 5 when dry or moist and chroma of 3 or 4. Texture is loam or silt loam.

Dinkels series

The Dinkels series consists of deep, well drained soils on the sides of upland plateaus and on low mountainsides. These soils formed in colluvium mixed with loess and volcanic ash. Slope ranges from 25 to 70 percent. Elevation is 800 to 3,200 feet. The average annual precipitation is 12 to 15 inches, and the mean annual air temperature is about 46 degrees F.

Typical pedon of Dinkels gravelly loam, 25 to 70 percent slopes, 1,500 feet northeast of the southwest corner of sec. 9, T. 26 N., R. 22 E.

A1—0 to 3 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; many medium tubular pores; 15 percent pebbles, 2 percent cobbles; mildly alkaline; clear smooth boundary.
A3—3 to 13 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist, weak medium granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; many medium tubular pores; 15 percent pebbles, 5 percent cobbles; mildly alkaline; gradual smooth boundary.
B21—13 to 24 inches; pale brown (10YR 6/3) gravelly sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few fine roots; few medium tubular pores; 20 percent pebbles, 5 percent cobbles; mildly alkaline; gradual smooth boundary.
B22—24 to 43 inches; pale brown (10YR 6/3) very gravelly coarse sandy loam, yellowish brown (10YR 5/4) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; few medium tubular pores; 25 percent pebbles, 10 percent cobbles, 5 percent stones; neutral; abrupt irregular boundary.
R—43 inches; slightly weathered fractured granite.

The profile is neutral or mildly alkaline. The control section averages 15 to 35 percent coarse fragments. Depth to granite ranges from 40 to 60 inches.

The A horizon has chroma of 2 or 3 when dry or moist.

The B horizon has value of 5 or 6 when dry and 4 or 5 when moist. It has chroma of 2 or 3 when dry and 3 or 4 when moist. Texture is gravelly loam, gravelly coarse sandy loam, gravelly sandy loam, or very gravelly coarse sandy loam.

Dougville series

The Dougville series consists of very deep, well drained soils on basalt plateaus. These soils formed in loess mixed with volcanic ash and cinders. Slope ranges from 0 to 15 percent. Elevation is 2,400 to 3,200 feet. The average annual precipitation is 10 to 12 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Dougville loam, 0 to 15 percent slopes, in the southwest corner of sec. 3, T. 25 N., R. 22 E.

Ap—0 to 9 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and

nonplastic; many fine roots; few medium tubular pores; 5 percent pumiceous pebbles; neutral; gradual smooth boundary.
B2—9 to 24 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist, weak medium and coarse prismatic structure; soft, very friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; 5 percent pumiceous pebbles; neutral; gradual smooth boundary.
C1—24 to 42 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; few fine tubular pores; 5 percent pumiceous pebbles; mildly alkaline; abrupt smooth boundary.
IIC—42 to 60 inches; light yellowish brown (10YR 6/4) heavy silt loam, dark brown (10YR 4/3) moist; massive; hard, friable, nonsticky and slightly plastic; very few fine roots; common fine and medium tubular pores; moderately alkaline.

The profile contains small amounts of pumice and small cinders. The mollic epipedon is less than 20 inches thick.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It has chroma of 2 or 3 when dry.

The B horizon has value of 4 or 5 when dry and 2 or 3 when moist. Texture is loam or silt loam.

The C1 horizon has value of 5 or 6 when dry and 3 or 4 when moist. Texture is loam or silt loam.

The IIC horizon has value of 5 or 6 when dry and 4 or 5 when moist. It has chroma 3 or 4. Texture is heavy silt or silt loam.

Ellisforde series

The Ellisforde series consists of very deep, well drained soils on terraces and terrace escarpments. These soils formed in loess overlying lake sediment. Slope ranges from 0 to 60 percent. Elevation is 700 to 2,100 feet. The average annual precipitation is 8 to 10 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of Ellisforde loam, 0 to 15 percent slopes, near the S1/4 corner of sec. 8, T. 28 N., R. 27 E.

A1—0 to 12 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; few fine tubular pores; mildly alkaline; gradual smooth boundary.
B2—12 to 27 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 3/3) moist, weak medium prismatic structure; soft, very friable, nonsticky and nonplastic; common fine roots; common medium and fine tubular pores; mildly alkaline; clear smooth boundary.
IICca—27 to 60 inches; light gray (10YR 7/2) stratified silt loam and very fine sandy loam, grayish brown (10YR 5/2) moist; massive; hard, firm, slightly sticky and slightly plastic; few fine roots; many very fine tubular pores; strongly alkaline.

The profile is neutral to strongly alkaline. Alkalinity increases with depth. Depth to secondary carbonates ranges from 24 to 30 inches.

The A horizon has texture of loam or fine sandy loam.

The B horizon has chroma of 2 to 4 when dry and moist. It has value of 3 or 4 when moist. Texture is silt loam or very fine sandy loam.

The IIC horizon has value of 6 or 7 when dry and 4 or 5 when moist. It has chroma of 2 or 3 when dry and 2 to 4 when moist. Texture is stratified silt loam, loam, and very fine sandy loam. A few strata of very fine sand are in some pedons.

Entiat series

The Entiat series consists of shallow, well drained soils on the sides of uplands. These soils formed in material weathered from granitic rock mixed with loess. Slope ranges from 25 to 70 percent. Elevation is 800 to 2,500 feet. The average annual precipitation is 9 to 12 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of an Entiat gravelly fine sandy loam in an area of Entiat-Rock outcrop complex, steep, 1,320 feet west of the E1/4 corner of sec. 16, T. 25 N., R. 21 E.

A1—0 to 6 inches; brown (10YR 5/3) gravelly fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine roots; few fine and medium tubular pores; 15 percent pebbles, 5 percent cobbles, stones, and boulders; mildly alkaline; clear wavy boundary.
B2—6 to 11 inches; yellowish brown (10YR 5/4) very gravelly loam, dark brown (10YR 3/3) moist, weak medium subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; common fine and medium roots; few fine and medium tubular pores; 30 percent pebbles, 12 percent cobbles; mildly alkaline; gradual wavy boundary.
C—11 to 17 inches; light yellowish brown (10YR 6/4) very gravelly loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, nonsticky and slightly plastic; common fine and medium roots; many fine and medium tubular pores; 40 percent pebbles, 10 percent cobbles; mildly alkaline; abrupt wavy boundary.
Cr—17 inches; decomposing granodiorite.

The profile is neutral or mildly alkaline. The control section averages 35 to 70 percent coarse fragments that are mostly gravel. Depth to granodiorite ranges from 12 to 20 inches.

The B horizon has value of 5 or 6 when dry and chroma of 3 or 4 when dry and moist. Texture is very gravelly loam or very gravelly sandy loam.

The C horizon has value of 5 or 6 when dry and 3 or 4 when moist. It has chroma of 3 or 4 when dry. Texture is very gravelly loam, very gravelly sandy loam, or very gravelly fine sandy loam.

Esquatzel series

The Esquatzel series consists of very deep, well drained soils on low terraces and bottom lands. These soils formed in alluvium. Slope ranges from 0 to 2 percent. Elevation is 800 to 1,900 feet. The average annual precipitation is 7 to 10 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of Esquatzel loam (fig. 8), 1,320 feet west of the southeast corner of sec. 32, T. 23 N., R. 25 E.

Ap—0 to 10 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak medium platy structure; soft, very friable, nonsticky and nonplastic; few fine roots; many very fine tubular pores; mildly alkaline; clear smooth boundary.

AC—10 to 22 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist, weak coarse prismatic structure; soft, very friable, nonsticky and nonplastic; few fine roots; common very fine tubular pores; mildly alkaline; gradual smooth boundary.

C1—22 to 34 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; very few very fine and fine tubular pores; moderately alkaline; clear smooth boundary.

C2—34 to 60 inches; light yellowish brown (10YR 6/4) stratified silt loam and very fine sandy loam, dark yellowish brown (10YR 3/4) moist; massive; soft, very friable, nonsticky and nonplastic; very few very fine tubular pores; moderately alkaline.

The profile is mildly alkaline or moderately alkaline. It contains a small amount of pumice. Thin strata of volcanic ash and coarse basaltic sand are in some pedons. Depth to free carbonates ranges from 30 to 40 inches.

The A horizon has chroma of 2 or 3 when dry and moist.

The AC horizon has value of 5 or 6 when dry and chroma of 3 or 4 when dry or moist. Texture is silt loam with lenses of very fine sandy loam in some pedons.

The C horizon has value of 5 or 6 when dry and 3 or 4 when moist. It has chroma of 3 or 4 dry and moist. Texture is silt loam with thin lenses of very fine sandy loam and fine sandy loam.

Finley series

The Finley series consists of very deep, well drained soils on terraces. These soils formed in alluvium mixed with loess in the surface layer. Slope ranges from 3 to 8 percent. Elevation is 800 to 1,000 feet. The average annual precipitation is 7 to 9 inches, and the mean annual air temperature is about 51 degrees F.

Figure 8.—Profile of Esquatzel loam. The lower part of the profile is massive stratified silt loam and very fine sandy loam.

Typical pedon of Finley loam, 3 to 8 percent slopes (fig. 9), 1,320 feet south and 500 feet west of the northeast corner of sec. 15, T. 22 N., R. 23 E.

A1—0 to 6 inches; light yellowish brown (10YR 6/4) loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; few fine tubular pores; 5 percent pebbles; mildly alkaline; clear smooth boundary.

B2—6 to 22 inches; pale brown (10YR 6/3) very gravelly loam, dark brown (10YR 4/3) moist, weak coarse prismatic structure; soft, very friable, nonsticky and

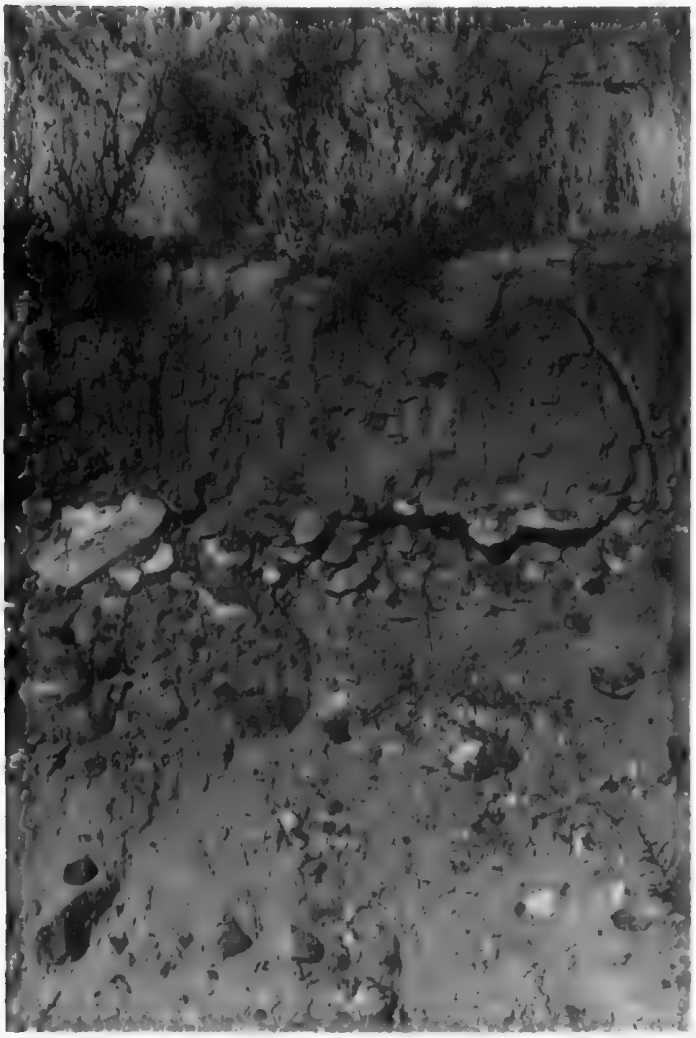

Figure 9.—Profile of Finley loam, 3 to 8 percent slopes, show the weak coarse prismatic structure of the subsoil between depths of 6 and 22 inches. The lower part of the substratum is extremely gravelly loamy sand.

nonplastic; common fine roots; few fine tubular pores; 30 percent pebbles, 10 percent cobbles; moderately alkaline; clear smooth boundary.

C1—22 to 26 inches; light gray (10YR 7/2) extremely gravelly loam, dark brown (10YR 4/3) moist; massive; soft, friable, nonsticky and nonplastic; few fine roots; few fine tubular pores; 65 percent pebbles, 10 percent cobbles; moderately alkaline; slightly effervescent; abrupt wavy boundary.

IIC2—26 to 60 inches; multicolored extremely gravelly loamy sand; single grain; loose; 65 percent pebbles, 25 percent cobbles; moderately effervescent; moderately alkaline.

The profile is mildly alkaline or moderately alkaline. The control section averages more than 35 percent gravel and cobbles. Depth to lime ranges from 16 to 40 inches. Small volcanic cinders are in most horizons.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist. It has chroma of 3 or 4 when dry.

The B2 horizon has value of 5 or 6 when dry and 3 or 4 when moist. It has chroma of 3 or 4 when dry and 2, 3, or 4 when moist. Texture is very gravelly loam or very fine sandy loam.

The C1 horizon has value of 6 or 7 when dry and 4 to 6 when moist. It has chroma of 2 or 3 when moist. Coarse fragments are covered with a coating of lime and silica.

Heytou series

The Heytou series consists of very deep, well drained soils on broad basalt uplands. These soils formed in glacial till mixed with loess in the upper part. Slope ranges from 0 to 30 percent. Elevation is 1,000 to 3,000 feet. The average annual precipitation is 9 to 12 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Heytou very stony loam, 0 to 30 percent slopes, 1,320 feet east of the northwest corner of sec. 26, T. 27 N., R. 24 E.

A1—0 to 10 inches; grayish brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; many very fine tubular pores; 20 percent pebbles, 10 percent cobbles, 5 percent stones, 1 percent boulders; some stones on surface; mildly alkaline; clear smooth boundary.

B2—10 to 19 inches; dark brown (10YR 4/3) very cobbly loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine roots; common fine tubular pores; 25 percent pebbles, 15 percent cobbles, 5 percent stones, 1 percent boulders; mildly alkaline; clear smooth boundary.

C1—19 to 26 inches; gray (10YR 5/1) very cobbly loam, dark grayish brown (10YR 4/2) moist; massive; soft, friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; 25 percent pebbles, 15 percent cobbles, 5 percent stones, 1 percent boulders; moderately alkaline; abrupt smooth boundary.

C2ca—26 to 32 inches; light gray (10YR 7/1) very cobbly loam, grayish brown (10YR 5/2) moist; massive; hard, very firm, slightly sticky and slightly plastic; few medium tubular pores; discontinuous lenses of soft lime about 1/8 inch thick; 30 percent pebbles, 10 percent cobbles, 5 percent stones, 1 percent boulders; strongly alkaline; clear smooth boundary.

C3—32 to 60 inches; grayish brown (10YR 5/2) very cobbly loam, dark grayish brown (10 YR 4/2) moist;

massive; slightly hard, friable, nonsticky and nonplastic; few medium tubular pores; 30 percent pebbles, 15 percent cobbles, 5 percent stones, 1 percent boulders; slightly effervescent; moderately alkaline.

Depth to the C2ca horizon ranges from 20 to 36 inches. The control section is 35 to 60 percent coarse fragments.

The A horizon has value of 4 or 5 when dry and chroma of 2 or 3 when moist or dry.

The B horizon has value of 4 or 5 when dry and chroma of 1 to 3 when dry or moist. It is gravelly, cobbly, very gravelly, or very cobbly loam or sandy loam.

The C horizons have value of 5 to 7 when dry and 4 or 5 when moist. They have chroma of 1 or 2 when dry or moist. Texture is very gravelly or very cobbly loam or sandy loam. Strata of coarse sand are in some pedons. Lime and silica coatings are on the undersides of cobbles and stones in some pedons. Gravel and cobbles are mainly basalt.

Kiona series

The Kiona series consists of deep, well drained soils on canyonsides. These soils formed in colluvium mixed with loess. Slope ranges from 25 to 70 percent. Elevation is 1,000 to 2,500 feet. The average annual precipitation is 7 to 9 inches, and the mean annual air temperature is about 51 degrees F.

Typical pedon of a Kiona extremely stony loam, in an area of Kiona-Rubble land association, steep, 850 feet southeast of the northwest corner of sec. 33, T. 22 N., R. 22 E.

A1—0 to 5 inches; yellowish brown (10YR 5/4) extremely stony loam, dark brown (10YR 3/3) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; many medium and large tubular pores; 30 percent stones, 10 percent cobbles, 10 percent pebbles; mildly alkaline; gradual wavy boundary.

B2—5 to 20 inches; yellowish brown (10YR 5/4) very cobbly silt loam, dark brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine roots; many medium and large tubular pores; 10 percent stones, 35 percent cobbles, 15 percent pebbles; mildly alkaline; gradual wavy boundary.

C—20 to 60 inches; yellowish brown (10YR 5/4) very cobbly silt loam, dark brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine roots; many medium and large tubular pores; 10 percent stones, 30 percent cobbles, 10 percent pebbles; mildly alkaline.

The control section is 35 to 80 percent coarse basalt fragments. Thin coatings of lime and silica are on most coarse fragments.

The A horizon has value of 4 or 5 when dry and chroma of 2 to 4 when dry and 2 or 3 when moist.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist. It has chroma of 2, 3, or 4 when dry and 2 or 3 when moist. Texture is very gravelly loam, very cobbly silt loam, or very cobbly loam.

The C horizons have value of 5 or 6 when dry and 4 or 5 when moist. They have chroma of 2 to 4 when dry and 2, 3, or 4 when moist. Texture is very cobbly silt loam, very cobbly loam, or extremely cobbly silt loam. Thin mycelial segregations of lime are present.

Lickskillet series

The Lickskillet series consists of shallow, well drained soils on basalt uplands and canyonsides. These soils formed in weathered basalt mixed with loess and colluvium. Slope ranges from 3 to 25 percent. Elevation is 1,000 to 3,200 feet. The average annual precipitation is 7 to 12 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of a Lickskillet cobbly silt loam, in an area of Zen-Bakeoven-Lickskillet association, undulating, 700 feet southwest of the E1/4 corner of sec. 10, T. 20 N., R. 22 E.

A1—0 to 4 inches; brown (10YR 5/3) cobbly silt loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common very fine tubular pores; 15 percent pebbles, 5 percent cobbles, with some cobbles on surface; mildly alkaline; clear smooth boundary.

B21—4 to 9 inches; brown (10YR 5/3, 5/4) gravelly loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common very fine tubular pores; 30 percent pebbles, 5 percent cobbles; mildly alkaline; gradual smooth boundary.

B22—9 to 18 inches; yellowish brown (10YR 5/4) very gravelly heavy silt loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and plastic; few fine roots; common very fine tubular pores; 30 percent pebbles, 5 percent cobbles; mildly alkaline; abrupt smooth boundary.

IIR—18 inches; basalt.

The profile is mildly alkaline or moderately alkaline. The control section averages 35 to 65 percent coarse fragments that are mostly gravel. Depth to basalt ranges from 12 to 20 inches.

The A horizon has chroma of 2 or 3 when dry or moist.

The B horizon has hue of 7.5YR or 10YR and value of 4 to 6 when dry and 3 or 4 when moist. It has chroma of 3 or 4 when dry and 2 to 4 when moist. Texture is gravelly or very gravelly loam or silt loam.

Magallon series

The Magallon series consists of very deep, somewhat excessively drained soils on terraces. These soils formed in glacial outwash mixed with loess in the surface layer. Slope ranges from 3 to 15 percent. Elevation is 700 to 1,500 feet. The average annual precipitation is 8 to 10 inches, and the mean annual air temperature is about 51 degrees F.

Typical pedon of Magallon fine sandy loam, 3 to 8 percent slopes, 1,320 feet southwest of the E1/4 corner of sec. 14, T. 22 N., R. 21 E.

Ap—0 to 10 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak thick platy structure; soft, very friable, nonsticky and nonplastic; common fine roots; very few very fine tubular pores; mildly alkaline; clear smooth boundary.

B2—10 to 19 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; few fine roots; very few very fine tubular pores; mildly alkaline; clear wavy boundary.

C1—19 to 24 inches; light yellowish brown (10YR 6/4) loamy fine sand, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; very few fine tubular pores; mildly alkaline; clear wavy boundary.

C2—24 to 60 inches; light yellowish brown (10YR 6/4) fine sand, dark brown (10YR 4/3) moist; single grain; loose; mildly alkaline.

Depth to fine sand ranges from 20 to 36 inches. A few basalt pebbles are in some profiles.

The A horizon has value of 4 or 5 when dry and chroma of 2 or 3 when moist or dry.

The B horizon has chroma of 3 or 4 when dry or moist and value of 3 or 4 when moist.

The C horizon has chroma of 4 or 5 when dry and 3 or 4 when moist. It is multicolored in some pedons. Texture is loamy sand or loamy fine sand in the upper part and fine or medium sand in the lower part.

Malaga series

The Malaga series consists of very deep, somewhat excessively drained soils on terraces. These soils formed in alluvium mixed with loess overlying glacial outwash. Slope ranges from 0 to 8 percent. Elevation is 600 to 1,000 feet. The average annual precipitation is 8 to 10 inches, and the mean annual air temperature is about 51 degrees F.

Typical pedon of Malaga gravelly fine sandy loam, 0 to 8 percent slopes, 600 feet southwest of the northeast corner of sec. 27, T. 22 N., R. 21 E.

Ap—0 to 4 inches; brown (10YR 5/3) gravelly fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, very friable, nonsticky and nonplastic; many fine roots; few fine tubular pores; 15 percent pebbles, 3 percent cobbles; mildly alkaline; clear smooth boundary.

B2—4 to 12 inches; dark brown (7.5YR 4/4) gravelly fine sandy loam, dark brown (7.5YR 4/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; few medium and large tubular pores; 30 percent fine pebbles, 5 percent cobbles; mildly alkaline; clear smooth boundary.

B3—12 to 28 inches; brown (7.5YR 5/4) extremely gravelly fine sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few fine roots; few fine tubular pores; 65 percent pebbles, 5 percent cobbles; neutral; abrupt wavy boundary.

IIC—28 to 60 inches; multicolored extremely gravelly sand; single grain; loose; 80 percent pebbles, 10 percent cobbles, 2 percent stones; neutral.

Depth to the IIC horizon is 16 to 28 inches. The control section averages 50 to 90 percent coarse fragments.

The A horizon has chroma of 3 or 4 when dry and 2 or 3 when moist. It has value of 3 or 4. Texture is gravelly or cobbly fine sandy loam.

The B2 horizon has hue of 7.5YR or 10YR, value of 4 or 5 when dry, and chroma of 3 or 4 when dry and 2 to 4 when moist. Texture is gravelly or very gravelly fine sandy loam or loam.

The B3 horizon has hue of 7.5YR to 10YR and value of 4 or 5 when dry and 3 or 4 when moist. Texture is very gravelly or extremely gravelly fine sandy loam or sandy loam.

Pogue series

The Pogue series consists of very deep, somewhat excessively drained soils on terraces. These soils formed in alluvium mixed with loess overlying glacial outwash. Slope ranges from 0 to 25 percent. Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, and the mean annual air temperature is about 51 degrees F.

Typical pedon of Pogue fine sandy loam, 0 to 3 percent slopes, 1,000 feet west of the E1/4 corner of sec. 20, T. 22 N., R. 21 E.

Ap—0 to 6 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium crumb structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; few very fine tubular pores; 10 percent pebbles, 5 percent cobbles; neutral; gradual smooth boundary.

B2—6 to 24 inches; brown (10YR 5/3) cobbly fine sandy loam, dark brown (10YR 5/3) moist; weak coarse

prismatic structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; few very fine tubular pores; 10 percent cobbles, 10 percent pebbles; neutral; gradual wavy boundary.

B3—24 to 31 inches; yellowish brown (10YR 5/4) extremely gravelly sandy loam, dark yellowish brown (10YR 3/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; very few roots; few fine tubular pores; 50 percent pebbles, 15 percent cobbles, 5 percent stones; neutral; abrupt wavy boundary.

IIC—31 to 60 inches; very cobbly sand; single grain; loose; 20 percent cobbles, 20 percent pebbles, 10 percent stones, 5 percent boulders.

Depth to the IIC horizon ranges from 24 to 38 inches. The profile averages less than 35 percent coarse fragments above the IIC horizon. The IIC horizon averages more than 35 percent coarse fragments.

The A horizon has value of 4 or 5 when dry and chroma of 2 or 3 when dry or moist. Texture is fine sandy loam or gravelly, cobbly, extremely stony, or bouldery fine sandy loam.

The B horizon has value of 5 or 6 when dry and chroma of 2 to 4 when dry. Texture is fine sandy loam, gravelly or cobbly fine sandy loam, or very fine sandy loam. It is extremely gravelly sandy loam in some pedons.

The IIC horizon is very gravelly sand, very gravelly loamy sand, or very cobbly sand.

Quincy series

The Quincy series consists of very deep, somewhat excessively drained soils on terraces and sides of terraces. These soils formed in eolian material. Slope ranges from 0 to 25 percent. Elevation is 600 to 1,200 feet. The average annual precipitation is 8 to 10 inches, and the mean annual air temperature is about 51 degrees F.

Typical pedon of Quincy loamy fine sand, 0 to 15 percent slopes, 740 feet east of the S1/4 corner of sec. 22, T. 23 N., R. 20 E.

Ap—0 to 10 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; mildly alkaline; clear smooth boundary.

C—10 to 60 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; common fine roots to a depth of 30 inches, few roots at a depth of 30 to 48 inches; very few fine pores; mildly alkaline.

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist. It has chroma of 2 or 3 when dry and moist. Texture is loamy fine sand or fine sand.

The C horizon has value of 6 or 7 when dry and chroma of 2 or 3 when dry and moist. It is stratified with layers of loamy fine sand or coarse sand in some pedons. Some pedons have unconforming material such as old alluvium, lacustrine deposits, outwash gravel, or ablation till deposits below a depth of 40 inches.

Ralls series

The Ralls series consists of very deep, well drained soils on sides of uplands. These soils formed in colluvium mixed with loess. Slope ranges from 25 to 65 percent. Elevation is 1,500 to 3,000 feet. The average annual precipitation is 9 to 12 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of a Ralls very cobbly silt loam (fig. 10), in an area of Ralls-Renslow-Bakeoven association,

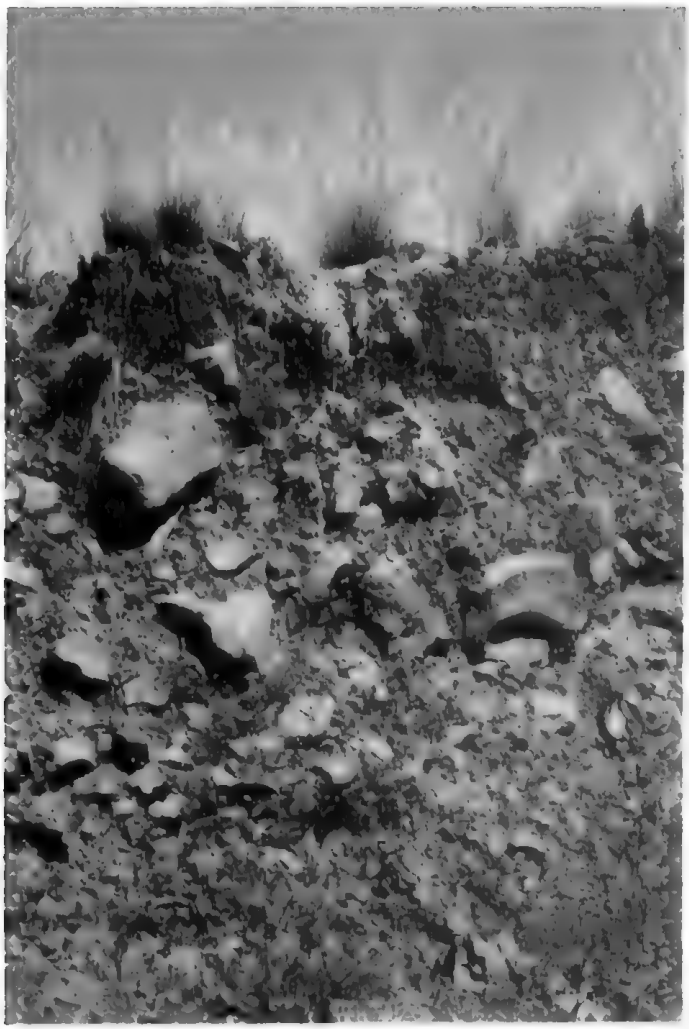

Figure 10.—Profile of Ralls very cobbly silt loam, 25 to 65 percent slopes. The very cobbly silt loam surface layer is colluvium mixed with loess.

steep, 1,200 feet north and 1,200 feet east of the southwest corner of sec. 6, T. 23 N., R. 21 E.

A1—0 to 10 inches; grayish brown (10YR 5/2) very cobbly silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many medium and coarse tubular pores; 15 percent pebbles, 15 percent cobbles, 5 percent stones; mildly alkaline; gradual smooth boundary.

B2t—10 to 20 inches; dark brown (10YR 4/3) gravelly clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; few fine and very fine tubular pores; thin continuous clay films on peds; 20 percent pebbles, 5 percent cobbles; mildly alkaline; clear wavy boundary.

B3—20 to 32 inches; yellowish brown (10YR 5/4) gravelly silt loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few large tubular pores; 25 percent pebbles, 10 percent cobbles; mildly alkaline; gradual smooth boundary.

C—32 to 60 inches; yellowish brown (10YR 5/4) very gravelly silt loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common, medium, and fine tubular pores; 45 percent angular basalt pebbles, 15 percent cobbles; moderately alkaline.

The profile is mildly alkaline or moderately alkaline. The control section averages less than 35 percent rock fragments.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist.

The B horizon has value of 4 or 5 when dry and 3 or 4 when moist. It has chroma of 3 or 4 when dry or moist. Texture ranges from gravelly clay loam to cobbly silt loam.

The C horizon has value of 5 to 7 when dry and 3 to 6 when moist. Chroma is 2 to 4 when dry and moist. Texture ranges from gravelly clay loam to extremely gravelly silt loam. The C horizon has some cobbles and stones.

Renslow series

The Renslow series consists of very deep, well drained soils on broad basalt plateaus. These soils formed in loess. Slope ranges from 0 to 30 percent. Elevation is 1,500 to 3,200 feet. The average annual precipitation is 9 to 12 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of a Renslow silt loam, in an area of Renslow-Zen association, undulating, 1,000 feet south of the northwest corner of sec. 30, T. 24 N., R. 24 E.

Ap—0 to 10 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable, nonsticky and nonplastic; many fine roots; many fine tubular pores; mildly alkaline; clear smooth boundary.

B1—10 to 24 inches; yellowish brown (10YR 5/4) silt loam, dark brown (10YR 3/3) moist; weak medium prismatic structure; slightly hard, friable, nonsticky and slightly plastic; many fine roots; few fine tubular pores; mildly alkaline; gradual smooth boundary.

B2t—24 to 31 inches; light yellowish brown (10YR 6/4) heavy silt loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; few medium tubular pores; mildly alkaline; clear smooth boundary.

Cca—31 to 60 inches; yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; few fine roots; common, fine, and medium tubular pores; moderately alkaline; moderately effervescent.

The profile is mildly alkaline or moderately alkaline. Occasional small volcanic cinders are in some pedons. Depth to lime ranges from 24 to 40 inches.

The A horizon has chroma of 2 or 3 when dry and moist.

The B horizon has value of 4, 5, or 6 when dry and chroma of 3 or 4 when dry or moist.

The C horizon has value of 5 or 6 when dry and 4 or 5 when moist. It has chroma of 3 or 4 when dry and moist. White mycelial segregations of lime are common in the C horizon.

Rock Creek series

The Rock Creek series consists of shallow, well drained soils on mountainsides and ridgetops. These soils formed in residuum derived from basalt mixed with loess. Slope ranges from 0 to 30 percent. Elevation is 2,400 to 4,200 feet. The average annual precipitation is 12 to 15 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Rock Creek very cobbly silt loam, 3 to 30 percent slopes, 1,320 feet west of the S1/4 corner of sec. 14, T. 24 N., R. 21 E.

A1—0 to 3 inches; brown (7.5YR 5/3) very cobbly silt loam, dark brown (7.5YR 3/2) moist; weak medium granular structure; soft, very friable, nonsticky and slightly plastic; many fine roots; many medium and large tubular pores; 15 percent pebbles, 5 percent cobbles; some cobbles and stones on surface; neutral; abrupt smooth boundary.

B21t—3 to 5 inches; brown (7.5YR 5/4) very gravelly clay loam, dark brown (7.5YR 4/4) moist; weak medium prismatic structure; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine and medium tubular pores; 35 percent pebbles, 5 percent cobbles; neutral; clear smooth boundary.

B22t—5 to 8 inches; dark brown (7.5YR 4/4) very gravelly clay, dark brown (7.5YR 3/4) moist; moderate fine prismatic structure; hard, firm, very sticky and very plastic; few fine roots; many fine and medium tubular pores; 45 percent pebbles, 10 percent cobbles; thin clay films on ped faces and coarse fragments; neutral; clear smooth boundary.
B23t—8 to 12 inches; dark brown (7.5YR 4/4) extremely cobbly clay, dark brown (7.5YR 3/4) moist; massive; hard, firm, very sticky and plastic; few fine roots; common fine tubular pores; 55 percent pebbles, 30 percent cobbles; thin clay films on ped faces and coarse fragments; neutral; clear smooth boundary.
IIR—12 inches; basalt.

The control section ranges from 35 to 90 percent coarse fragments. Most coarse fragments are in the lower part. Depth to basalt is 8 to 20 inches. A few scattered boulders are on the surface.

The A horizon has hue of 7.5YR or 10YR and value of 4 or 5 when dry and 3 or 4 when moist. It has chroma of 2 to 4 when dry and 2 or 3 when moist.

The B horizon has hue of 7.5YR or 10YR and value of 4 or 5 when dry and 3 or 4 when moist. It has chroma of 3 or 4 when dry and moist. Texture is very gravelly, very cobbly, extremely gravelly, or extremely cobbly clay or clay loam.

Strat series

The Strat series consists of very deep, well drained soils on outwash plains and terraces. These soils formed in glacial outwash mixed with loess in the upper part. Slope ranges from 3 to 25 percent. Elevation is 1,200 to 1,850 feet. The average annual precipitation is 9 to 12 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Strat very cobbly silt loam, 3 to 25 percent slopes, 360 feet east of the southwest corner of sec. 31, T. 23 N., R. 25 E.

A1—0 to 10 inches; brown (10YR 5/3) very cobbly silt loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; many fine and medium tubular pores; 20 percent pebbles, 15 percent cobbles; many cobbles on surface; mildly alkaline; clear smooth boundary.
B2—10 to 18 inches; pale brown (10YR 6/3) very cobbly loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots; few fine tubular pores; 20 percent pebbles, 40 percent cobbles; mildly alkaline; gradual smooth boundary.
C—18 to 22 inches; yellowish brown (10YR 5/4) very gravelly loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; few fine tubular pores; 40 percent pebbles, 15 percent cobbles; mildly alkaline; abrupt wavy boundary.
IIC2si—22 to 60 inches; yellowish brown (10YR 5/4) extremely gravelly sand, dark yellowish brown (10YR 4/4) moist; single grain; loose; 75 percent pebbles, 10 percent cobbles, 5 percent stones; rock fragments mainly basalt with white silica coatings on undersides; mildly alkaline.

Depth to the IIC horizon ranges from 18 to 36 inches. The control section averages 35 to 80 percent rock fragments. Reaction is mildly alkaline or moderately alkaline throughout.

The A horizon has chroma of 2 or 3 when moist or dry.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist. It is very cobbly or very gravelly loam.

The C horizon has value of 5 or 6 when dry and chroma of 3 or 4 when moist or dry. It is very gravelly or very cobbly loam.

The IIC horizon has value of 5 to 7 when dry and 4 to 6 when moist and chroma of 3 or 4 when moist or dry. It is extremely gravelly sand or extremely gravelly coarse sand.

Supplee series

The Supplee series consists of very deep, well drained soils on terraces. These soils formed in loess, volcanic ash, and pumice over glacial outwash. Slope ranges from 3 to 15 percent. Elevation is 1,000 to 1,700 feet. The average annual precipitation is 9 to 12 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of Supplee very fine sandy loam, 3 to 8 percent slopes, 600 feet south of the E1/4 corner of sec. 14, T. 26 N., R. 21 E.

Ap—0 to 6 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; few fine tubular pores; 2 percent pumice pebbles; mildly alkaline; abrupt smooth boundary.
B2—6 to 19 inches; pale brown (10YR 6/3) very fine sandy loam, dark brown (10YR 4/3) moist; weak medium prismatic structure; soft, very friable, nonsticky and nonplastic; few fine roots; few medium tubular pores; 10 percent pumice pebbles; mildly alkaline; clear wavy boundary.
B3—19 to 30 inches; light yellowish brown (10YR 6/4) gravelly very fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; very few fine roots; few fine and very fine tubular pores; 20 percent pumice pebbles; neutral; clear wavy boundary.
IIC—30 to 60 inches; extremely cobbly sand; single grain; loose; 35 percent pebbles, 25 percent cobbles, 10 percent stones, 5 percent boulders; neutral.

Depth to the IIC horizon ranges from 20 to 40 inches. The upper part of the control section ranges from 2 to 25 percent pumice gravel.

The A horizon has value of 4 to 6 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry or moist. Structure is weak granular or platy. The A horizon is neutral or mildly alkaline.

The B horizon has value of 5 or 6 when dry and 3 or 4 when moist. It has chroma of 2 to 4 when dry and 2 or 3 when moist. Structure is prismatic or subangular blocky in the upper part and prismatic or massive in the lower part. Texture is very fine sandy loam, loam, or fine sandy loam. Gravel and cobbles are in some pedons. The B horizon ranges from neutral to moderately alkaline.

The IIC horizon is extremely cobbly sand or extremely gravelly sand. It ranges from neutral to moderately alkaline. Some pedons have silica and lime coatings on the undersides of rock fragments.

Timentwa series

The Timentwa series consists of deep, well drained soils on basalt plateaus. These soils formed in loess overlying glacial till. Slope ranges from 0 to 15 percent. Elevation is 2,400 to 2,600 feet. The average annual precipitation is 12 to 15 inches, and the mean annual air temperature is about 47 degrees F.

Typical pedon of Timentwa loam, 0 to 15 percent slopes (fig. 11), at the southwest corner of sec. 12, T. 25 N., R. 27 E.

Ap—0 to 10 inches; grayish brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; many fine tubular pores; neutral; gradual smooth boundary.

A12—10 to 18 inches; brown (10YR 5/3) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots; many fine tubular pores; 15 percent pebbles; mildly alkaline; clear smooth boundary.

B21—18 to 28 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, friable, nonsticky and slightly plastic; few fine roots; many fine tubular pores; 20 percent pebbles; mildly alkaline; gradual smooth boundary.

B22—28 to 41 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist, weak medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; 20 percent pebbles; mildly alkaline; abrupt wavy boundary.

IIC1casi—41 to 52 inches; gray (10YR 6/1) very gravelly loam, dark grayish brown (10YR 4/2) moist; massive; very hard, very firm, nonsticky and nonplastic; common very fine tubular pores; 30 percent pebbles, 5 percent cobbles, 3 percent stones; discontinuous, weakly cemented lenses of lime and silica 1/8 inch thick; slightly effervescent; moderately alkaline; clear wavy boundary.

IIC2ca—52 to 60 inches; grayish brown (10 5/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; massive; hard, firm, nonsticky and nonplastic; common medium tubular pores; 30 percent pebbles, 5 percent cobbles, 3 percent stones, occasional boulders; slightly effervescent; moderately alkaline.

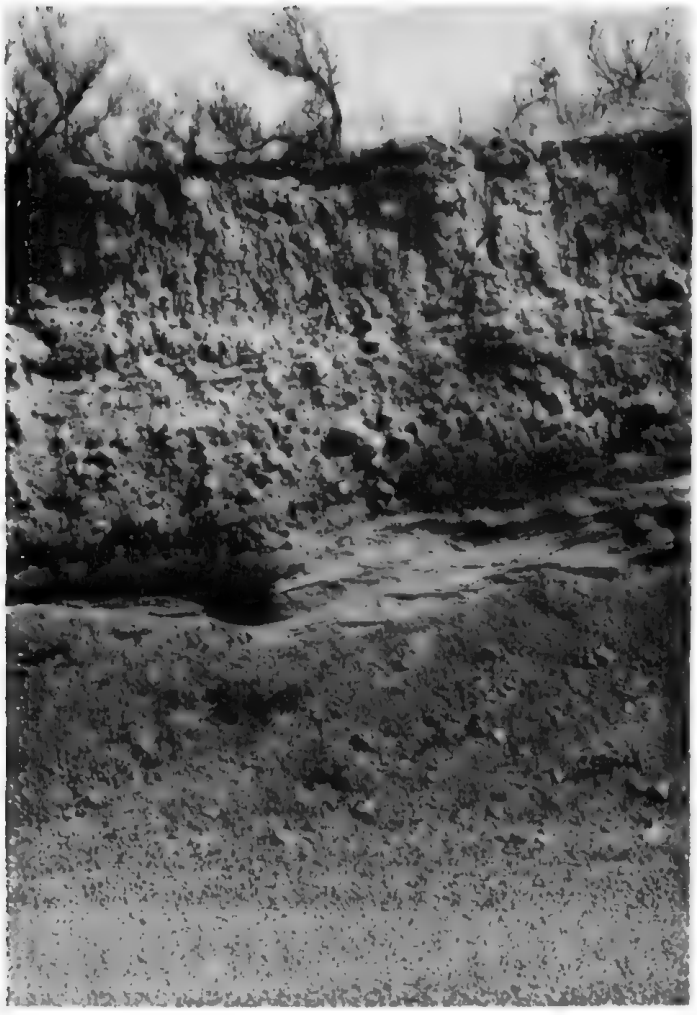

Figure 11.—Profile of Timentwa loam, 0 to 15 percent slopes. A weakly cemented duripan that restricts root penetration is at a depth of 41 inches. This soil formed in loess overlying glacial till.

The control section averages 15 to 35 percent coarse fragments. Depth to the duripan ranges from 40 to 55 inches.

The A horizon has value of 4 or 5 when dry and 2 or 3 when moist. It has chroma of 2 or 3 when dry or moist. Content of rock fragments ranges from 0 to 30 percent.

The B horizon has value of 4 or 5 when dry and chroma of 2 or 3 when dry or moist. Texture is loam or fine sandy loam. The B horizon is 10 to 35 percent coarse fragments.

The C horizons have hue of 2.5YR or 10YR and value of 5 or 6 when dry and 3 or 4 when moist. They have chroma of 1 or 2 when dry or moist. Texture ranges from sandy loam to loam and is very gravelly or very cobbly in some pedons.

Touhey series

The Touhey series consists of very deep, well drained soils on broad basalt plateaus and uplands. These soils formed in glacial till mixed with loess in the upper part. Slope ranges from 0 to 15 percent. Elevation is 1,500 to 3,000 feet. The average annual precipitation is 9 to 12 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Touhey loam, 0 to 15 percent slopes (fig. 12), 100 feet southeast of the southwest corner of sec. 23, T. 27 N., R. 26 E.

A1—0 to 10 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine tubular pores; 5 percent pebbles, few cobbles; mildly alkaline; clear smooth boundary.

B2—10 to 19 inches; yellowish brown (10YR 5/4) gravelly loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; few very fine tubular pores; 20 percent pebbles, 5 percent cobbles, 1 percent stones; mildly alkaline; clear smooth boundary.

C1si—19 to 28 inches; gray (10YR 5/1) gravelly loam, dark gray (10YR 4/1) moist; massive; very hard, firm, nonsticky and nonplastic; few very fine roots; few very fine tubular pores; 25 percent pebbles, 5 percent cobbles, 1 percent stones; moderately alkaline; abrupt smooth boundary.

C2casi—28 to 32 inches; gray (10YR 5/1) gravelly loam, dark gray (10YR 4/1) moist; massive; very hard, firm, nonsticky and nonplastic; few very fine tubular pores; few discontinuous cemented lenses of lime and silica less than 1/8 inch thick; 25 percent pebbles, 5 percent cobbles, 2 percent stones; strongly effervescent; strongly alkaline; clear smooth boundary.

C3—32 to 60 inches; gray (10YR 5/1) gravelly loam, dark gray (10YR 4/1) moist; massive; slightly hard, firm, nonsticky and nonplastic; common medium tubular pores; 25 percent pebbles, 5 percent cobbles, 2 percent stones; strongly alkaline.

Depth to the C2casi horizon ranges from 20 to 36 inches. The control section averages 20 to 35 percent rock fragments.

Figure 12.—Profile of Touhey loam, 0 to 15 percent slopes. A weakly cemented hardpan that restricts root penetration is at a depth of 28 inches. This soil formed in loess over glacial till.

The A horizon has chroma of 2 or 3 when dry or moist.

The B horizon has value of 4 or 5 and chroma of 2 to 4 when dry. It is gravelly loam, gravelly fine sandy loam, loam, or fine sandy loam.

The C horizon has value of 5 to 7 when dry and 4 or 5 when moist. It has chroma of 1 or 2 when dry or moist. The C horizon is gravelly loam or cobbly loam. Strata of coarse sand are in some pedons. White coatings of lime and silica are on the undersides of some cobbles and stones.

Umapine Variant

The Umapine Variant consists of moderately deep, moderately well drained soils on low terraces. These soils formed in alluvium. Slope ranges from 0 to 2 percent. Elevation is 1,200 to 1,900 feet. The average annual precipitation is 7 to 12 inches, and the mean annual air temperature is about 50 degrees F.

Typical pedon of a Umapine Variant loam, near the center of sec. 11, T. 28 N., R. 27 E.

A1—0 to 10 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; weak medium crumb structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; few fine and very fine tubular pores; mildly alkaline; clear smooth boundary.

ACca—10 to 20 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, nonsticky and slightly plastic; common fine roots; common fine and very fine tubular pores; strongly alkaline; clear smooth boundary.

C1ca—20 to 29 inches; pale brown (10YR 6/3) loam, olive (5YR 5/3) moist; massive; soft, friable, nonsticky and nonplastic; common fine roots; common very fine, fine, and medium tubular pores; very strongly alkaline; abrupt smooth boundary.

C2casi—29 to 36 inches; weakly cemented duripan that breaks down to light brownish gray (10YR 6/2) heavy silt loam, dark grayish brown (10YR 4/2) moist; massive; hard, very firm, slightly sticky and slightly plastic; few fine roots; many fine tubular pores and common large tubular pores; very strongly alkaline; clear smooth boundary.

C3—36 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; soft, friable, nonsticky and slightly plastic; common fine and medium tubular pores; very strongly alkaline.

The profile ranges from mildly alkaline to very strongly alkaline. Depth to the duripan ranges from 20 to 40 inches. The surface layer contains more volcanic ash than the rest of the profile.

The A and AC horizons have value of 5 or 6 when dry and 3 or 4 when moist and chroma of 2 or 3 when dry and moist.

The C1 horizon has value of 5 to 7 when dry and 4 to 6 when moist and chroma of 2 or 3 when dry and moist. Texture is loam or silt loam.

The duripan ranges from weakly cemented to strongly cemented. It is 7 to 16 inches thick.

Willis series

The Willis series consists of moderately deep, well drained soils on basalt plateaus. These soils formed in loess. Slope ranges from 3 to 15 percent. Elevation is 1,500 to 3,000 feet. The average annual precipitation is about 9 to 12 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Willis silt loam, 3 to 15 percent slopes, 1,320 feet east and 250 feet north of the southwest corner of sec. 36, T. 25 N., R. 23 E.

Ap—0 to 10 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; very few fine tubular pores; 2 percent basalt pebbles; mildly alkaline; gradual smooth boundary.

B2—10 to 20 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 3/3) moist; weak medium and coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; 2 percent basalt pebbles; mildly alkaline; gradual smooth boundary.

C1ca—20 to 28 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; massive; soft, friable, slightly sticky and slightly plastic; few fine roots; very few fine tubular pores; 10 percent basalt pebbles; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C2sim—28 inches; indurated, lime- and silica-cemented hardpan.

The profile ranges from neutral to moderately alkaline. Depth to the hardpan ranges from 20 to 40 inches. Some pedons have a small amount of pumice in the profile.

The A horizon has chroma of 2 or 3 when dry or moist.

The B horizon has value of 4 to 6 when dry and 3 to 5 when moist. It has chroma of 2 or 3 when dry and 2 to 4 when moist.

The C1 horizon has value of 4 to 6 when dry or moist. It has chroma of 3 or 4 when moist.

Zen series

The Zen series consists of moderately deep, well drained soils on broad basalt plateaus. These soils formed in loess. Slope ranges from 0 to 15 percent. Elevation is 1,500 to 3,200 feet. The average annual precipitation is 9 to 12 inches, and the mean annual air temperature is about 49 degrees F.

Typical pedon of Zen silt loam, in an area of Renslow-Zen association, undulating, 1,000 feet southwest of the N1/4 corner of sec. 27, T. 22 N., R. 22 E.

A1—0 to 9 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable, nonsticky and slightly plastic; many fine roots; few fine tubular pores; neutral; clear smooth boundary.

A3—9 to 18 inches; dark brown (10YR 4/3) heavy silt loam, dark brown (10YR 3/3) moist; moderate

medium prismatic structure; very hard, friable, slightly sticky and slightly plastic; few fine roots; very few fine tubular pores; mildly alkaline; gradual smooth boundary.

B2—18 to 24 inches; yellowish brown (10YR 5/4) heavy silt loam, dark brown (10YR 4/3) moist; weak medium prismatic structure; very hard, friable, slightly sticky and slightly plastic; few fine roots; very few fine tubular pores; mildly alkaline; gradual wavy boundary.

B3—24 to 34 inches; light yellowish brown (10YR 6/4) silt loam, dark brown (10YR 4/3) moist; massive; hard, friable, nonsticky and slightly plastic; few fine roots; few fine and medium tubular pores; moderately alkaline; abrupt smooth boundary.

IIR—34 inches; basalt.

Depth to basalt is 20 to 40 inches.

The A horizon has value of 4 or 5 when dry and chroma of 2 or 3 when dry or moist.

The B horizons have value of 4 to 6 when dry and 3 to 5 when moist and chroma of 3 or 4 when dry or moist.

formation of the soils

This section describes how soil-forming factors have influenced the soils in Douglas County.

factors of soil formation

Soil is a near continuum over much of the earth's surface. The parent materials have been modified over a period of time by climate and biotic effects, which may be controlled locally by topography. The properties of an individual soil are determined by five factors: (1) the composition of the *parent material;* (2) the *climate* under which the soil material has accumulated and has existed since accumulation; (3) the *topography,* or relief of the land; (4) *living organisms;* and (5) the length of *time* the forces of soil formation have acted on the parent material. Soils differ according to the relative degree of influence of each soil-forming factor.

parent material

The soils of Douglas County formed in material weathered from glacial till and outwash, loess, volcanic ash and pumice, basalt, granite, sedimentary and metamorphic rocks, alluvium, eolian sand, and lake sediment.

During the late Pleistocene Epoch, the Wisconsin Glacier entered what is now the northern part of Douglas County. As the ice moved south, it mixed preexisting residual soils with material that was carried along and ground up by the ice sheets. This mixture, known as glacial till, was left on the surface after the ice melted. It was reworked slightly by water in some areas. In most places, the till is an unconsolidated, heterogeneous mixture of silt, clay, sand, gravel, cobbles, and a few stones and boulders. It has a definite grayish color. There are a few very large boulders, or "haystack rocks," on the surface (fig. 13). Where no till was deposited, there are occasional basalt or granite bedrock outcrops.

Generally, a layer of till up to 50 feet deep covers the northern half of the county, north of the terminal moraine where the glacier ended. This till is covered by loess to a depth of 1 to 3 feet in most places. Drumlins, kames, kettles, and eskers are in this part of the county. The semiarid climate has preserved these landforms, and they are easily recognized. Heytou soils are on the steeper and stonier drumlines, kames, eskers, and terminal moraines; Touhey soils are on the more level ground moraine areas.

As the ice melted, streams and rivers flowed from the front of the ice, down coulees and stream valleys, and deposited thick beds of glacial outwash composed of gravel, cobbles, and sand. Strat and Finley soils formed in the outwash deposits that were later covered by a thin deposit of loess.

Loess is the predominant parent material in the southern half of the county. It is part of a large deposit, the Palouse Formation, that extends from east-central Oregon, north-northeast along the western slopes of the Blue Mountains, across southeastern Washington, and into Idaho. This formation consists of four layers of firm wind-deposited material that is mostly silt. These layers were deposited at different geological times. The bottom layer of loess is more than 50,000 years old and is called pre-Bull Lake. Above this is Bull Lake, which was deposited 32,000 to 50,000 years ago. Next is the Pinedale, which was deposited 6,700 to 25,000 years ago. The youngest is the post-Pinedale, which has been deposited during the past 6,700 years (*5*).

The loess was deposited on the basalt plateau up to a depth of 20 feet; the average depth is 4 to 5 feet. The last deposition contains more volcanic ash than the earlier deposits. Most of the ash came from a volcanic eruption of Mt. Mazama in Oregon approximately 6,600 years ago. Renslow, Broadax, Zen, and Condon soils developed in loess. Renslow and Broadax soils are more than 40 inches deep over the basalt; Zen and Condon soils are 20 to 40 inches deep over the basalt.

Along the western part of the plateau there are small areas of the Ellensburg Formation, which consists of interbedded claystone and conglomerate materials. Where these silty and clayey deposits are near the surface, fine textured soils formed.

In addition to being deposited directly on basalt, loess was also deposited on a hard lime-silica cemented hardpan. This hardpan, in places, covers the basalt to a depth of about 1 foot. It most likely resulted from soil-forming processes, and most of the soil over the hardpan was later eroded away.

In the central part of the county there is a large area underlain by a hardpan. Willis soils developed in loess that now covers the hardpan to a depth of 20 to 40 inches.

A volcanic eruption of Glacier Peak in the Cascade Mountains approximately 12,000 years ago spread much volcanic ash and pumice to the east. Soils along the northwestern edge of Douglas County have a lot of this ash and pumice mixed in the upper part of the profile.

Figure 13.—Large glacial-deposited boulders, or "haystack" rocks, occur throughout the northern half of the county. This soil is Touhey loam, 0 to 15 percent slopes.

Chelan soils developed in materials primarily from this volcanic activity. A fine pumice from this eruption, however, can be found in all soils of the county. The narrow low terraces along Douglas Creek just below the community of Douglas consist mostly of fine pumice carried there by water from the surrounding uplands.

The plateau part of the county is underlain by Miocene basalt flows. This basalt is exposed or has a very shallow covering of loess along the southern edge of the county, on the south slopes of Badger Mountain, and along the sides of Moses Coulee. Bakeoven, Lickskillet, and Rock Creek soils occur in these areas where the soils are 4 to 20 inches deep over basalt. In most places, the basalt is only slightly weathered. Just above the basalt in some areas, however, there is a thin clay layer developed by weathering. Clay can also be found in fractures in the upper part of the basalt.

The slopes from the plateau to the Columbia River along the county on the north and west are underlain by granite, granodiorite, gneiss, or schist, except at the top of the slopes where they are basalt. Where these rocks are near the surface, they are only slightly weathered. Entiat soils formed in weathered granitic rocks with loess mixed in the surface layer. They are 12 to 20 inches deep over bedrock. Soils on the steep side slopes that are underlain by basalt contain a lot of pebbles and cobbles mixed throughout. Some loess is mixed in the surface layer. Badge, Ralls, and Kiona soils formed in these basaltic, gravelly materials on slopes.

Soils that formed in alluvium occur mostly on terraces and flood plains along the Columbia River and in the bottoms of streams and valleys. Magallon and Pogue soils occur on terraces and have a gravel or sand substratum. Esquatzel soils formed in recent deep alluvium in lower Moses Coulee in sediment eroded from the adjacent loessial uplands.

Eolian sand is the parent material of Quincy soils. It is found mostly on river terraces and on nearby upland slopes where the sand was deposited by wind. Large areas of Quincy soils are in the East Wenatchee area.

Lake sediment is layered, quite silty, and generally free of pebbles and cobbles. It is the parent material for soils such as the Ellisforde soils. These soils are in rather small areas on river terraces and also on terraces along Foster Creek.

climate

Climate directly affects the formation of soils. Temperature and precipitation are the main climate factors, although wind is also important.

Temperature and moisture determine to a large extent the rate at which minerals are weathered and released to the soil and also the depth at which soluble materials accumulate. They also affect the translocation of clays, the reduction and transfer of iron, and, to a large extent, the amount and kind of vegetation and the rate at which vegetation decomposes. The amount and timing of moisture affects the rate of erosion.

The annual precipitation in Douglas County varies from 6 to 15 inches. Precipitation is lowest in July, August, and September and gradually reaches a maximum in midwinter. Most of the winter precipitation is in the form of snow.

The county is divided into three precipitation zones: 6 to 9 inches, 9 to 12 inches, and 12 to 15 inches. The driest areas are the lower parts of Moses Coulee and Rock Island Creek. These areas are also the lowest. With increasing elevation, the annual precipitation increases and at 4,200 feet at the top of Badger Mountain the annual precipitation is about 15 inches.

The depth to lime in the soil is determined largely by the amount of precipitation the soil receives. Lime is leached deeper in the soils that receive more precipitation. For example, in Finley soils, which formed under 6 to 9 inches of annual precipitation, the depth to lime is about 22 inches. In Renslow soils, which formed under 9 to 12 inches, the depth to lime is commonly 30 to 32 inches. Broadax soils, which formed under 12 to 15 inches, are free of lime to a depth of about 36 inches in most areas.

There has also been more alluvial clay and hence a more developed subsoil in soils in the 12- to 15-inch precipitation zone. A few clay films occur in the subsoil of Broadax soils.

Mean annual temperatures vary with the precipitation zones. The 6- to 9-inch zone is quite hot in the summer and has a mean annual air temperature of about 51 degrees F. The 9- to 12-inch zone has a mean annual air temperature of about 49 degrees F, and the 12- to 15-inch zone about 47 degrees F. The north side of Badger Mountain is quite shaded, and mean annual soil temperatures are less than 47 degrees F. Dinkels and Cordy soils occur here.

The soil is generally frozen for a period each winter in all three precipitation zones, but usually for only a short time in the warmest zone. If rain falls on this frozen soil or if snow melts too rapidly in spring, severe erosion can occur. There may also be flooding and deposition damage along streams. During the summer, heavy local rains and hailstorms can cause severe erosion and runoff in some areas.

topography

Topography influences soil formation through its effect on drainage, runoff, erosion, evaporation, soil temperature, and vegetation. Elevation, steepness, and aspect are important elements of topography in Douglas County.

Douglas County has four major types of topography. The first type occurs along the Columbia River. It consists mainly of fluvial terraces with some alluvial fans near streams and rivers. This area has elevations of about 600 to 2,000 feet. Precipitation is generally about 8 to 10 inches annually in this area, but small areas such as the land near the Washington State University Tree Fruit Research Center, Columbia View plots, receive only 7 inches annually. These areas of lower rainfall are affected by the rain shadow of the Cascade Mountains directly west in Chelan County. Almost all soils in this area are underlain by thick strata of gravel, cobbles, and sand deposited by the Columbia River during the time glacial ice was melting and the river was very high. Most of the irrigated orchardland in the county is on stream terraces. Magallon and Pogue soils are representative of the soils in this area.

The second major type of topography is the long, steep slopes of the basalt plateaus. Elevations range from about 1,000 to 3,200 feet. From Rocky Reach Dam north the slopes are underlain by granite, gneiss, or schist except near the top of the slopes where they are underlain by basalt. From Rocky Reach Dam south the slopes are underlain by basalt. In the granitic area, the soils are shallow and quite gravelly and cobbly. Either the slopes received little or no loess deposition, or else water erosion washed away the loess about as fast as it accumulated. Some deep, loose, stony talus slopes are in these areas with shallower soil as well as some rock outcrops. Entiat soils are common on the slopes underlain by granite, gneiss, or schist. In the basalt areas, soils on the slopes tend to be deeper, although they are very gravelly, cobbly, or stony. Kiona and Ralls soils are in this area. A high amount of basalt outcrop and talus slopes are also in this area and were mapped as Rock outcrop and Rubble land.

The third and most extensive type of topography is the basalt uplands or plateaus. Elevations range from approximately 2,200 to 3,000 feet. The basalt consists of multiple flows averaging 50 feet in thickness. The basalt is thin near the breaks leading to the river and thicker in the southern part of the county. An uplift of this basalt

created Badger Mountain. The northern part of this plateau is covered by glacial till and the southern part has a 4- to 5-foot thick loess mantle.

The fourth type of topography consists of the Badger Mountain area. Elevations here are 3,000 to 4,240 feet. The growing season is shorter at these higher elevations, and more of the precipitation is snow. These conditions favor forest vegetation, especially on the more shaded north side of the mountain. Soils that formed under this forest are slightly more acid and have a surface layer lighter in color than soils formed in the surrounding grasslands. Cordy and Dinkels soils are found here. These soils have a moderate amount of Glacier Peak volcanic ash mixed in the profile. This ash increases the water-holding capacity of the soil slightly, although in summer the soils get very dry and powdery.

living organisms

Plants, micro-organisms, earthworms, humans, and other forms of life are important in determining the rate and nature of soil formation. To a large measure, soil formation actually begins when plants begin to grow and animals begin to utilize the plant products. The most obvious effect of vegetation is the addition of organic matter, which tends to darken the soil and promote a granular structure. Plants also draw moisture and nutrients from the soil, intercept runoff, and reduce soil erosion. Their roots penetrate and improve aeration and permeability of the soil. Plant roots also help keep the surface layer supplied with nutrients by moving them up from a lower depth. In addition, vegetation provides protection against loss of water by shading the soil and reducing evaporation. When plants and animals die their remains are returned to the soil, where earthworms and burrowing animals help mix them with the soil material. Bacteria and fungi then change this organic matter into humus. Bacteria are more abundant than fungi in grasslands, and fungi are generally more abundant in the more acid soils of forest areas. The decomposition products react chemically with the mineral components of the soil mass, making the minerals more available for plant use.

The soils in Douglas County formed under two main zonal climax plant associations and approximately five edaphic, on soil-related, climax associations. The two zonal associations are big sagebrush-bluebunch wheatgrass and threetip sagebrush-Idaho fescue. The big sagebrush-bluebunch wheatgrass association occurs mostly in the 9- to 12-inch precipitation zone in Douglas County. Renslow soils, which have a brown silt loam surface layer about 10 inches thick, are typical of the soils here. The organic matter content is about 1 to 2 percent. The threetip sagebrush-Idaho fescue association occurs at a higher elevation in the 12- to 15-inch precipitation zone. Broadax soils are representative of the soils. They have a grayish brown silt loam surface layer about 13 inches thick and an organic matter content of 2 to 3 percent.

Human civilization, chiefly cultivation, has resulted in water and wind erosion in many places on these two associations. The degree of erosion ranges from slight on nearly level slopes to severe on many knolls and steep slopes, where nearly all the surface layer has been lost. The dry years of the 1930's resulted in much wind erosion in the Farmer-Withrow area. As much as 18 inches of the upper part of the soil was removed in places.

The edaphic climax association of big sagebrush-needleandthread occurs mostly on the terraces along the Columbia River where the soils are generally lighter textured and gravelly. Much of this land is in irrigated apple, pear, peach, apricot, and cherry orchards. These soils formed under about 6 to 10 inches of precipitation in Douglas County. The Finley soils developed under 6 to 9 inches of precipitation. They have a light yellowish brown, loam surface layer about 6 inches thick. Organic matter content is generally less than 1 percent. With more precipitation and higher elevation the organic matter content increases, and the surface layer becomes darker and deeper.

Another edaphic association is bitterbrush-needleandthread. It usually occurs on foot slopes and areas of terraces that are quite sandy and gravelly and that have some volcanic ash mixed in the soil profile. Some of the Dinkels soils developed under this association type.

The association of stiff sagebrush and wild buckwheat-Sandberg bluegrass occurs in small areas scattered over the county. The soils are shallow or very shallow and have some rock outcrops. Bakeoven soils, which have a dark brown or very dark brown surface layer, are representative of the soils in these areas.

The association of giant wildrye-saltgrass is found in low, rather small basins and potholes on the plateau, mostly in the glaciated area and also on the nearly level land along Foster Creek. The soils in these areas are somewhat poorly or moderately well drained and have quite a high pH reaction and salt and alkali content. Umapine Variant soils are representative. They have a rather light-colored surface because of the low amount of bunchgrass grown on them. Greasewood replaces giant wildrye where the pH exceeds 9.5, resulting in a greasewood-saltgrass association. The soils in this association are surrounded by soils in the big sagebrush-bluebunch wheatgrass association.

The last important edaphic plant association in Douglas County is of the ponderosa pine-bitterbrush and the Douglas-fir-pinegrass. These are mostly on the north slopes of Badger Mountain. Leaves and twigs from this type of vegetation are generally slower to decompose than the organic matter from grasses, and the organic material is deposited on, rather than in, the soil. Consequently, the soils have a lighter color (gray brown) than the surrounding grasslands. This vegetative association is on the Cordy soils. Pasturing and logging have changed the native vegetation in many places.

time

Soil formation begins as soon as rock is exposed on the earth's surface, a new layer of alluvium is deposited by streams, or a fresh mantle of loess is laid down by the wind. As soil formation progresses, characteristic layers called horizons develop (*7*). An estimate of age or maturity of soil is generally based on the kind, thickness, and arrangement of these horizons. Generally, the greater the number of horizons and the greater their thickness and distinctness, the older the soil. Depending upon the nature of the parent material and the vigor of the soil-forming processes, it takes from several to thousands of years to develop pronounced genetic horizons.

The parent materials in Douglas County are relatively young. The basalt is Miocene age and most of the loess is of middle to late Pleistocene or Holocene age. The stream sediments are Holocene; in some places, they were deposited in the early part of this century.

The Esquatzel soils developed in recent alluvium. They have a rather thin, light-colored surface layer and show very little development in the subsoil. The oldest soil in the county is probably Broadax soil. It has a brown, silt loam surface layer and a silty clay loam B horizon. Broadax soil formed in old loess with a mantle of more recent loess. It is more than 12,000 years old. Most of the other soils in the county, such as Renslow and Touhey soils, are between these extremes. Renslow soils have a dark surface, a subsoil that has weak or moderate structure, and carbonates in the C horizon.

Most soils in the county have quite recent deposits of volcanic ash mixed in the surface layer. Most of this ash came from the volcanic eruption of Mt. Mazama in Oregon about 6,600 years ago (*5*).

Pogue and Malaga soils formed in glacial outwash in terraces near the Columbia River. The outwash is probably 10,000 to 12,000 years old and was deposited when the glaciers were melting.

Along the Columbia River, the application of irrigation water over the past 50 years has accelerated the development of soils so that some soils in these areas now have a much darker and deeper surface layer.

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glossary

ABC soil. A soil having an A, a B, and a C horizon.

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Low	0 to 3.75
Moderate	3.75 to 7.5
High	More than 7.5

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having base-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Cement rock. Shaly limestone used in the manufacture of cement.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Chiseling. Loosening the soil, without inverting and with a minimum of mixing of the surface layer, to shatter restrictive layers in the upper 16 inches that inhibit water movement or root development.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or modules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A crop of close-growing grasses, legumes, or small grain grown for seasonal erosion control or for permanent cover in orchards and vineyards.

Culmination of the mean annual increment (CMAI). The age or rotation at which growing stock of a forest produces the greatest annual growth (for that time period).

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion. A channel with a supporting ridge on the lower side constructed across the slope to divert excess water to where it can be used or disposed of safely.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some

are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle every other year in rotation with small grain. Weeds are controlled and moisture conserved during the idle year to retain adequate moisture for the crop year. This 2-year rotation is common in regions of limited rainfall. Also known as summer fallow.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial melt water. Many deposits are interbedded or laminated.

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts excess surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure crop. A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A severely eroded site with steep ditches cut by running water which ordinarily flows only after rainfall. The distinction between a gully and a rill is one of depth and location. A gully is generally an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage. Gullies are in depressional drainage patterns. A rill is less than a foot in depth, can usually be smoothed over by ordinary tillage, and is on field slopes.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Properly timed, non-inversion conservation tillage that is limited to those operations essential to produce a crop and prevent soil damage. The purpose of minimum tillage is to avoid deterioration of soil structure, to reduce soil compaction and formation of tillage pans, and to improve soil aeration, permeability, and tilth.

Miscellaneous areas. Areas that have little or no natural soil and support little or no vegetation.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *tillage pan, hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability on an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH

7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A visible erosion pattern resulting from rainfall or snowmelt runoff. Usually referred to as sheet and rill erosion. (See Gully.)

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables.) Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have about the same profile, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water. Also called "inter-rill" erosion.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope gradient. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope length. The distance from the point of origin of overland water flow to the point where either the slope gradient decreases enough that sediment deposition begins, or the runoff water enters a well-defined channel that may be part of a drainage network or a constructed channel.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	Less than 13:1
Moderate	13-30:1
Strong	More than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands to reduce erosion. The crops are arranged so that a protective strip of grass or close-growing crop is alternated with a strip of clean-tilled crop or fallow. *Contour strips* follow the contour and are designed to reduce sheet and rill erosion and control water. *Field strips* are across the general slope and also reduce sheet and rill erosion. *Wind strips* are arranged generally perpendicular to prevailing winds to control wind erosion, trap snow, and increase soil moisture.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Small grain residue left on the surface of the soil over a two year period. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Loosening the soil, without inverting and with a minimum of mixing of the surface layer, to shatter restrictive layers deeper than 16 inches that restrict water movement or root development.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, channel, or a combination ridge and channel constructed across the slope (gradient terrace) or on the contour (level terrace) to (1) reduce slope length, (2) reduce erosion, (3) reduce sediment content in runoff water, (4) intercept and conduct surface runoff at a non-erosive velocity to a stable outlet, (5) retain runoff for moisture conservation, (6) prevent gully development, (7) reform the land surface, (8) improve farmability, and (9) reduce flooding.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by melt water streams, in a glacial lake or other body of still water in front of a glacier.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION AT WATERVILLE, WASHINGTON

[Recorded in the period 1951-77]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F		In	In	In		In
January	31.3	14.4	22.9	50	-13	11	1.47	.57	2.20	5	16.7
February	38.2	20.1	29.2	53	-2	17	.84	.25	1.30	3	4.2
March	44.9	25.4	35.1	62	4	37	.76	.19	1.20	3	3.8
April	36.9	32.6	44.7	75	19	170	.72	.12	1.18	2	.6
May	66.6	40.1	53.3	86	25	417	.84	.21	1.34	2	.0
June	73.9	46.5	60.2	92	33	606	.80	.22	1.26	2	.0
July	83.2	51.4	67.4	98	37	849	.29	---	.50	1	.0
August	81.5	51.1	66.3	99	38	815	.79	---	1.36	2	.0
September	72.7	43.7	58.2	91	28	546	.49	.02	.83	1	.0
October	58.5	34.0	46.3	78	19	213	.74	.13	1.20	2	.2
November	42.3	24.8	33.5	61	3	29	1.39	.31	2.10	5	6.8
December	33.2	17.7	25.5	49	-7	8	1.70	.39	2.59	7	18.9
Yearly:											
Average	56.9	33.5	45.2	---	---	---	---	---	---	---	---
Extreme	---	---	---	100	-17	---	---	---	---	---	---
Total	---	---	---	---	---	3,718	10.83	8.91	12.67	35	51.2

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--TEMPERATURE AND PRECIPITATION AT WENATCHEE, WASHINGTON

[Recorded in the period 1951-77]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F		In	In	In		In
January----	34.5	21.6	28.1	35	-3	28	1.35	.51	2.01	5	12.2
February---	43.5	26.8	35.2	61	9	68	.79	.23	1.23	3	3.8
March------	53.3	31.7	42.5	69	16	128	.62	.13	1.00	2	2.5
April------	63.8	39.2	51.5	81	28	345	.61	.09	1.02	2	.0
May--------	72.6	47.4	60.1	91	32	623	.57	.18	.92	2	.0
June-------	79.7	54.7	67.2	96	42	816	.55	.11	.89	2	.0
July-------	87.5	59.5	73.6	103	47	1,042	.15	---	.26	1	.0
August-----	86.3	58.4	72.3	102	45	1,001	.71	---	1.22	2	.0
September--	77.5	49.6	63.6	94	37	708	.32	---	.54	1	.0
October----	62.6	39.2	50.9	79	26	338	.58	.07	.96	2	.1
November---	46.5	31.1	38.9	64	15	81	1.14	.38	1.74	4	3.4
December---	37.2	25.8	31.5	37	6	27	1.43	.57	2.12	5	11.2
Yearly:											
Average--	62.1	40.4	51.3	---	---	---	---	---	---	---	---
Extreme--	---	---	---	103	-5	---	---	---	---	---	---
Total----	---	---	---	---	---	5,205	8.82	7.16	10.40	31	33.2

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 3.--FREEZE DATES IN SPRING AND FALL
AT WATERVILLE, WASHINGTON

[Based on data recorded in the period 1951-77]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 6	May 23	June 8
2 years in 10 later than--	April 27	May 15	May 31
5 years in 10 later than--	April 11	April 29	May 16
First freezing temperature in fall:			
1 year in 10 earlier than--	October 5	September 22	September 13
2 years in 10 earlier than--	October 11	September 28	September 18
5 years in 10 earlier than--	October 23	October 9	September 27

TABLE 4.--FREEZE DATES IN SPRING AND FALL
AT WENATCHEE, WASHINGTON

[Based on data recorded in the period 1951-77]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	March 29	April 12	May 3
2 years in 10 later than--	March 21	April 5	April 27
5 years in 10 later than--	March 5	March 22	April 17
First freezing temperature in fall:			
1 year in 10 earlier than--	October 29	October 18	October 1
2 years in 10 earlier than--	November 4	October 23	October 7
5 years in 10 earlier than--	November 17	November 4	October 19

TABLE 5.--GROWING SEASON LENGTH
AT WATERVILLE, WASHINGTON

[Based on data recorded in the period 1951-77]

Probability	Daily minimum temperature		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	160	130	107
8 years in 10	172	141	116
5 years in 10	195	162	133
2 years in 10	217	183	151
1 year in 10	229	194	160

TABLE 6.--GROWING SEASON LENGTH
AT WENATCHEE, WASHINGTON

[Based on data recorded in the period 1951-77]

Probability	Daily minimum temperature		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	229	197	158
8 years in 10	238	207	167
5 years in 10	256	226	185
2 years in 10	274	245	203
1 year in 10	284	255	212

TABLE 7.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
10	Aquolls, nearly level	9,089	0.8
11	Badge very cobbly silt loam, 25 to 65 percent slopes	3,170	0.3
12	Bakeoven-Lickskillet association, gently sloping	72,446	6.2
13	Bakeoven-Touhey association, gently sloping	119,417	10.2
14	Beverly fine sandy loam, 0 to 8 percent slopes	260	*
15	Beverly cobbly fine sandy loam, 0 to 8 percent slopes	440	*
16	Broadax-Condon association, rolling	26,391	2.3
17	Burbank loamy fine sand, 0 to 8 percent slopes	622	0.1
18	Burbank loamy fine sand, 8 to 25 percent slopes	459	*
19	Burch fine sandy loam, 8 to 15 percent slopes	485	*
20	Burch loam, 0 to 3 percent slopes	627	0.1
21	Burch loam, 3 to 8 percent slopes	919	0.1
22	Cashmere fine sandy loam, 0 to 3 percent slopes	748	0.1
23	Cashmere fine sandy loam, 3 to 8 percent slopes	3,634	0.3
24	Cashmere fine sandy loam, 8 to 15 percent slopes	1,018	0.1
25	Cashmont sandy loam, 3 to 8 percent slopes	619	0.1
26	Cashmont gravelly sandy loam, 3 to 8 percent slopes	646	0.1
27	Cashmont gravelly sandy loam, 8 to 15 percent slopes	614	0.1
28	Cashmont cobbly sandy loam, 3 to 15 percent slopes	580	*
29	Cashmont Variant, fine sandy loam, 3 to 8 percent slopes	713	0.1
30	Cashmont Variant, fine sandy loam, 8 to 15 percent slopes	278	*
31	Chelan very fine sandy loam, gravelly substratum, 0 to 8 percent slopes	607	0.1
32	Chelan association, bouldery	13,402	1.1
33	Chelan association, steep	4,726	0.4
34	Condon-Rock Creek-Broadax association, strongly sloping	16,392	1.4
35	Cordy association, steep	5,254	0.4
36	Cordy-Rock Creek association, steep	4,809	0.4
37	Dinkels gravelly loam, 25 to 70 percent slopes	8,939	0.8
38	Dougville loam, 0 to 15 percent slopes	10,788	0.9
39	Ellisforde fine sandy loam, 3 to 8 percent slopes	211	*
40	Ellisforde loam, 0 to 15 percent slopes	8,356	0.7
41	Ellisforde association, steep	8,712	0.7
42	Entiat-Rock outcrop complex, steep	23,451	2.0
43	Esquatzel loam	7,343	0.6
44	Finley loam, 3 to 8 percent slopes	1,180	0.1
45	Haploxerolls, nearly level	5,742	0.5
46	Haploxerolls, gently sloping	7,001	0.6
47	Heytou very stony loam, 0 to 30 percent slopes	126,860	10.8
48	Kiona-Rubble land association, steep	10,283	0.9
49	Magallon fine sandy loam, 3 to 8 percent slopes	1,411	0.1
50	Magallon fine sandy loam, 8 to 15 percent slopes	227	*
51	Malaga gravelly fine sandy loam, 0 to 8 percent slopes	1,744	0.1
52	Malaga cobbly fine sandy loam, 0 to 8 percent slopes	432	*
53	Pits, gravel	113	*
54	Pogue fine sandy loam, 0 to 3 percent slopes	850	0.1
55	Pogue fine sandy loam, 3 to 8 percent slopes	2,281	0.2
56	Pogue gravelly fine sandy loam, 8 to 15 percent slopes	256	*
57	Pogue gravelly fine sandy loam, 15 to 25 percent slopes	435	*
58	Pogue cobbly fine sandy loam, 0 to 15 percent slopes	1,717	0.1
59	Pogue extremely stony fine sandy loam, 3 to 25 percent slopes	1,713	0.1
60	Pogue bouldery fine sandy loam, 3 to 8 percent slopes	258	*
61	Pogue loam, 8 to 15 percent slopes	1,528	0.1
62	Quincy fine sand, 15 to 25 percent slopes	645	0.1
63	Quincy loamy fine sand, 0 to 15 percent slopes	7,201	0.6
64	Ralls-Renslow-Bakeoven association, steep	22,245	1.9
65	Renslow-Dougville association, undulating	21,888	1.9
66	Renslow-Zen association, undulating	157,901	13.5
67	Rock Creek very cobbly silt loam, 3 to 30 percent slopes	17,883	1.5
68	Rubble land-Rock outcrop complex	13,490	1.2
69	Umapine Variant loam	1,549	0.1
70	Strat very cobbly silt loam, 3 to 25 percent slopes	10,758	0.9
71	Supplee very fine sandy loam, 3 to 8 percent slopes	984	0.1
72	Supplee very fine sandy loam, 8 to 15 percent slopes	1,019	0.1
73	Timentwa loam, 0 to 15 percent slopes	10,223	0.9
74	Touhey loam, 0 to 15 percent slopes	276,417	23.7
75	Willis silt loam, 3 to 15 percent slopes	61,054	5.2

See footnote at end of table.

TABLE 7.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
76	Xerofluvents, nearly level	334	*
77	Xerorthents, very steep	7,021	0.6
78	Zen-Bakeoven-Lickskillet association, undulating	40,232	3.4
	Water	1,240	0.1
	Total	1,172,280	100.0

* Less than 0.1 percent.

TABLE 8.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Winter wheat and barley are grown in nonirrigated, summer fallow cropping systems; the other crops are irrigated. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Winter wheat	Barley	Grass-legume hay	Apples	Pears	Cherries	Peaches
	Bu	Bu	Ton	Boxes	Ton	Ton	Ton
10*. Aquolls							
11---------- Badge	---	---	---	---	---	---	---
12*: Bakeoven----------	---	---	---	---	---	---	---
Lickskillet----------	---	---	---	---	---	---	---
13*: Bakeoven----------	---	---	---	---	---	---	---
Touhey----------	---	---	---	---	---	---	---
14---------- Beverly	---	---	5.0	1,080	19.2	8.0	10.8
15---------- Beverly	---	---	4.0	1,080	18.0	7.5	9.6
16*: Broadax----------	50	45	---	---	---	---	---
Condon----------	30	35	---	---	---	---	---
17, 18---------- Burbank	---	---	4.0	840	18.0	7.0	9.6
19---------- Burch	---	---	7.0	1,440	24.0	10.0	14.4
20---------- Burch	---	---	7.0	1,440	24.0	10.0	14.4
21---------- Burch	---	---	7.0	1,440	24.0	10.0	14.4
22---------- Cashmere	---	---	7.0	1,440	24.0	10.0	14.4
23---------- Cashmere	---	---	7.0	1,440	24.0	10.0	14.4
24---------- Cashmere	---	---	7.0	1,440	24.0	10.0	14.4
25---------- Cashmont	---	---	7.0	1,440	24.0	10.0	14.4
26, 27---------- Cashmont	---	---	6.0	1,440	24.0	10.0	14.4
28---------- Cashmont	---	---	6.0	1,200	21.6	8.0	13.2
29---------- Cashmont Variant	---	---	5.0	1,200	21.6	9.0	13.2

See footnote at end of table.

TABLE 8.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Winter wheat	Barley	Grass-legume hay	Apples	Pears	Cherries	Peaches
	Bu	Bu	Ton	Boxes	Ton	Ton	Ton
30---------- Cashmont Variant	---	---	5.0	1,200	21.6	9.0	13.2
31---------- Chelan	35	30	7.0	1,200	24.0	10.0	14.4
32*:							
Chelan---------- (3 to 30 percent slopes)	---	---	---	---	---	---	---
Chelan. (30 to 65 percent slopes)							
33*:							
Chelan---------- (30 to 65 percent slopes)	---	---	---	---	---	---	---
Chelan---------- (3 to 30 percent slopes)	35	30	---	---	---	---	---
34*:							
Condon.							
Rock Creek----------	---	---	---	---	---	---	---
Broadax----------	---	---	---	---	---	---	---
35*:							
Cordy---------- (3 to 30 percent slopes)	---	---	---	---	---	---	---
Cordy---------- (30 to 55 percent slopes)	---	---	---	---	---	---	---
36*:							
Cordy----------	---	---	---	---	---	---	---
Rock Creek----------	---	---	---	---	---	---	---
37---------- Dinkels	---	---	---	---	---	---	---
38---------- Dougville	35	30	---	---	---	---	---
39---------- Ellisforde	---	---	7.0	1,320	21.6	9.0	14.4
40---------- Ellisforde	35	30	---	---	---	---	---
41*:							
Ellisforde---------- (15 to 30 percent slopes)	30	25	---	---	---	---	---
Ellisforde---------- (30 to 60 percent slopes)	---	---	---	---	---	---	---
42---------- Entiat-Rock outcrop	---	---	---	---	---	---	---
43---------- Esquatzel	40	35	7.5	---	---	---	---

See footnote at end of table.

TABLE 8.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Winter wheat	Barley	Grass-legume hay	Apples	Pears	Cherries	Peaches
	Bu	Bu	Ton	Boxes	Ton	Ton	Ton
44---------- Finley	---	---	---	---	---	---	---
45*, 46*. Haploxerolls							
47---------- Heytou	---	---	---	---	---	---	---
48*: Kiona----------	---	---	---	---	---	---	---
Rubble land.							
49---------- Magallon	25	20	5.0	1,320	21.6	9.0	13.2
50---------- Magallon	25	20	5.0	1,320	21.6	9.0	13.3
51, 52---------- Malaga	---	---	4.0	900	15.6	7.0	9.6
53*. Pits							
54---------- Pogue	---	---	6.0	1,440	24.0	10.0	14.4
55---------- Pogue	---	---	6.0	1,440	24.0	10.0	14.4
56, 57, 58, 59, 60-------- Pogue	---	---	4.0	1,200	21.6	9.0	13.3
61---------- Pogue	30	20	6.0	1,440	24.0	10.0	14.4
62---------- Quincy	---	---	3.0	1,080	16.8	7.0	12.0
63---------- Quincy	---	---	3.5	1,140	16.8	8.0	12.0
64*: Ralls----------	---	---	---	---	---	---	---
Renslow----------	---	---	---	---	---	---	---
Bakeoven----------	---	---	---	---	---	---	---
65*: Renslow---------- (0 to 15 percent slopes)	40	35	---	---	---	---	---
Dougville----------	35	30	---	---	---	---	---
Renslow---------- (15 to 30 percent slopes)	40	35	---	---	---	---	---
66*: Renslow----------	40	35	---	---	---	---	---
Zen----------	30	25	---	---	---	---	---

See footnote at end of table.

TABLE 8.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Winter wheat	Barley	Grass-legume hay	Apples	Pears	Cherries	Peaches
	Bu	Bu	Ton	Boxes	Ton	Ton	Ton
67---------- Rock Creek	---	---	---	---	---	---	---
68---------- Rubble land-Rock outcrop	---	---	---	---	---	---	---
69---------- Umapine Variant	---	---	---	---	---	---	---
70---------- Strat	---	---	---	---	---	---	---
71---------- Supplee	---	---	6.0	1,440	24.0	10.0	14.4
72---------- Supplee	---	---	6.0	1,440	24.0	10.0	14.4
73---------- Timentwa	45	30	---	---	---	---	---
74---------- Touhey	30	25	---	---	---	---	---
75---------- Willis	30	25	---	---	---	---	---
76*. Xerofluvents							
77*. Xerorthents							
78*:							
Zen----------	---	---	---	---	---	---	---
Bakeoven----------	---	---	---	---	---	---	---
Lickskillet----------	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
11---------- Badge	Loamy L2----------	Favorable	1,400	Bluebunch wheatgrass----------	50
		Normal	1,000	Idaho fescue----------	45
		Unfavorable	700	Threetip sagebrush----------	5
				Sandberg bluegrass----------	5
12*:					
Bakeoven----------	Very Shallow----------	Favorable	500	Stiff sagebrush----------	30
		Normal	400	Sandberg bluegrass----------	50
		Unfavorable	300	Eriogonum----------	5
Lickskillet-------	Shallow-2----------	Favorable	850	Bluebunch wheatgrass----------	75
		Normal	700	Sandberg bluegrass----------	10
		Unfavorable	350	Thurber needlegrass----------	5
				Phlox----------	5
13*:					
Bakeoven----------	Very Shallow----------	Favorable	500	Stiff sagebrush----------	30
		Normal	400	Sandberg bluegrass----------	50
		Unfavorable	300	Eriogonum----------	5
Touhey----------	Loamy L2----------	Favorable	1,400	Bluebunch wheatgrass----------	50
		Normal	1,200	Sandberg bluegrass----------	15
		Unfavorable	700	Balsamroot----------	10
				Big sagebrush----------	10
				Idaho fescue----------	15
16*:					
Broadax----------	Loamy L2----------	Favorable	1,400	Bluebunch wheatgrass----------	50
		Normal	1,000	Idaho fescue----------	20
		Unfavorable	700	Sandberg bluegrass----------	5
				Threetip sagebrush----------	5
Condon----------	Loamy L2----------	Favorable	1,200	Bluebunch wheatgrass----------	45
		Normal	900	Idaho fescue----------	30
		Unfavorable	600	Sandberg bluegrass----------	10
32*, 33*:					
Chelan----------	Loamy L2----------	Favorable	1,400	Bluebunch wheatgrass----------	50
		Normal	1,000	Needleandthread----------	15
		Unfavorable	700	Big sagebrush----------	10
				Sandberg bluegrass----------	5
34*:					
Condon----------	Loamy L2----------	Favorable	1,200	Bluebunch wheatgrass----------	45
		Normal	900	Idaho fescue----------	30
		Unfavorable	600	Sandberg bluegrass----------	10
Rock Creek--------	Very Shallow----------	Favorable	250	Sandberg bluegrass----------	40
		Normal	150	Stiff sagebrush----------	25
		Unfavorable	50	Eriogonum----------	20
				Bluebunch wheatgrass----------	5
Broadax----------	Loamy L2----------	Favorable	1,600	Bluebunch wheatgrass----------	50
		Normal	1,200	Idaho fescue----------	20
		Unfavorable	800	Sandberg bluegrass----------	5
				Threetip sagebrush----------	5
36*:					
Rock Creek--------	Very Shallow----------	Favorable	250	Sandberg bluegrass----------	40
		Normal	150	Stiff sagebrush----------	25
		Unfavorable	50	Eriogonum----------	20
				Bluebunch wheatgrass----------	5

See footnote at end of table.

TABLE 9.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
37. Dinkels	Loamy L2	Favorable	1,000	Bluebunch wheatgrass	75
		Normal	800	Sandberg bluegrass	5
		Unfavorable	600	Idaho fescue	20
38 Dougville	Loamy L2	Favorable	1,400	Bluebunch wheatgrass	55
		Normal	1,050	Big sagebrush	15
		Unfavorable	700	Idaho fescue	10
				Sandberg bluegrass	10
				Arrowleaf balsamroot	5
40 Ellisforde	Loamy L2	Favorable	925	Bluebunch wheatgrass	70
		Normal	800	Sandberg bluegrass	10
		Unfavorable	600	Big bluegrass	5
41*:					
Ellisforde (15 to 30 percent slopes)	Loamy L2	Favorable	925	Bluebunch wheatgrass	70
		Normal	800	Sandberg bluegrass	10
		Unfavorable	600	Big bluegrass	6
Ellisforde (30 to 60 percent slopes)	Loamy L2	Favorable	1,100	Bluebunch wheatgrass	70
		Normal	900	Sandberg bluegrass	10
		Unfavorable	700	Idaho fescue	5
				Big bluegrass	5
42*:					
Entiat	Shallow-2	Favorable	700	Bluebunch wheatgrass	50
		Normal	550	Thurber needlegrass	10
		Unfavorable	400	Arrowleaf balsamroot	5
				Antelope bitterbrush	5
				Sandberg bluegrass	10
Rock outcrop.					
44 Finley	Sandy Loam	Favorable	800	Bluebunch wheatgrass	40
		Normal	600	Needleandthread	15
		Unfavorable	300	Thurber needlegrass	10
				Sandberg bluegrass	5
				Biscuitroot	5
				Carey balsamroot	5
				Big sagebrush	5
47 Heytou	Loamy L2	Favorable	1,300	Bluebunch wheatgrass	45
		Normal	1,050	Needleandthread	15
		Unfavorable	650	Big sagebrush	15
				Balsamroot	10
48*:					
Kiona	Loamy L1	Favorable	700	Bluebunch wheatgrass	60
		Normal	550	Sandberg bluegrass	10
		Unfavorable	400	Thurber needlegrass	10
				Needleandthread	5
				Big sagebrush	5
Rubble land.					
59, 60 Pogue	Sandy Loam	Favorable	1,000	Bluebunch wheatgrass	65
		Normal	700	Needleandthread	15
		Unfavorable	400	Sandberg bluegrass	5
				Indian ricegrass	20
62, 63 Quincy	Sandy	Favorable	700	Needleandthread	40
		Normal	500	Sandberg bluegrass	5
		Unfavorable	300	Bluebunch wheatgrass	5
				Antelope bitterbrush	5
				Thickspike wheatgrass	5

See footnote at end of table.

TABLE 9.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
64*:					
Ralls	Loamy L2	Favorable	1,200	Bluebunch wheatgrass	45
		Normal	1,000	Threetip sagebrush	10
		Unfavorable	800	Idaho fescue	35
Renslow	Loamy L2	Favorable	1,200	Bluebunch wheatgrass	65
		Normal	900	Idaho fescue	5
		Unfavorable	600	Sandberg bluegrass	5
				Cusick bluegrass	5
				Big sagebrush	5
Bakeoven	Very Shallow	Favorable	500	Stiff sagebrush	70
		Normal	400	Sandberg bluegrass	20
		Unfavorable	300	Eriogonum	5
65*:					
Renslow	Loamy L2	Favorable	1,200	Bluebunch wheatgrass	65
		Normal	900	Idaho fescue	5
		Unfavorable	600	Sandberg bluegrass	5
				Cusick bluegrass	5
				Big sagebrush	5
Dougville	Loamy L2	Favorable	1,400	Bluebunch wheatgrass	55
		Normal	1,050	Big sagebrush	15
		Unfavorable	700	Idaho fescue	10
				Sandberg bluegrass	10
				Arrowleaf balsamroot	5
67 Rock Creek	Very Shallow	Favorable	250	Sandberg bluegrass	40
		Normal	150	Stiff sagebrush	25
		Unfavorable	50	Eriogonum	20
				Bluebunch wheatgrass	5
69 Umapine Variant	Alkali	Favorable	4,000	Giant wildrye	65
		Normal	3,000	Inland saltgrass	25
		Unfavorable	2,000	Alkali cordgrass	5
70 Strat	Shallow-2	Favorable	900	Bluebunch wheatgrass	70
		Normal	700	Sandberg bluegrass	10
		Unfavorable	500	Idaho fescue	5
				Big sagebrush	5
74 Touhey	Loamy L2	Favorable	1,400	Bluebunch wheatgrass	50
		Normal	1,200	Sandberg bluegrass	15
		Unfavorable	700	Balsamroot	10
				Big sagebrush	5
				Idaho fescue	15
75 Willis	Loamy L2	Favorable	800	Bluebunch wheatgrass	55
		Normal	500	Sandberg bluegrass	15
		Unfavorable	300	Thurber needlegrass	5
				Big sagebrush	5
78*:					
Zen	Loamy L2	Favorable	1,200	Bluebunch wheatgrass	65
		Normal	800	Sandberg bluegrass	10
		Unfavorable	600	Threetip sagebrush	5
				Idaho fescue	35
Bakeoven	Very Shallow	Favorable	500	Stiff sagebrush	70
		Normal	400	Sandberg bluegrass	20
		Unfavorable	300	Buckwheat	5
Lickskillet	Shallow 2	Favorable	850	Bluebunch wheatgrass	75
		Normal	700	Sandberg bluegrass	10
		Unfavorable	350	Thurber needlegrass	5
				Phlox	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
10*. Aquolls					
11. Badge					
12*: Bakeoven.					
Lickskillet.					
13*: Bakeoven.					
Touhey.					
14, 15---------- Beverly	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Green ash, ponderosa pine, Austrian pine, blue spruce, Douglas-fir.	Black locust, Lombardy poplar.
16*: Broadax----------	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, Rocky Mountain juniper, blue spruce.	Russian-olive, green ash, Austrian pine, Scotch pine, ponderosa pine, Douglas-fir.	Black locust------	---
Condon----------	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, Rocky Mountain juniper.	Russian-olive, ponderosa pine.	Black locust------	---
17, 18---------- Burbank	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Douglas-fir, ponderosa pine, green ash, Austrian pine, blue spruce.	Lombardy poplar, black locust.
19, 20, 21-------- Burch	---	Siberian peashrub, northern white-cedar.	Russian-olive-----	Green ash, ponderosa pine, Austrian pine, blue spruce, Douglas-fir.	Black locust, Lombardy poplar.
22, 23, 24-------- Cashmere	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Poplar, green ash, Russian-olive, ponderosa pine, Austrian pine, blue spruce, Douglas-fir.	Black locust, Lombardy poplar.
25, 26, 27-------- Cashmont	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Green ash, blue spruce, ponderosa pine, Austrian pine, Douglas-fir.	Lombardy poplar, black locust.

See footnote at end of table.

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
28---------- Cashmont	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Ponderosa pine, blue spruce, Douglas-fir, green ash, Austrian pine.	Black locust, Lombardy poplar.
29, 30---------- Cashmont Variant	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Green ash, Douglas-fir, Austrian pine, ponderosa pine, blue spruce.	Lombardy poplar, black locust.
31---------- Chelan	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Green ash, ponderosa pine, Austrian pine, blue spruce, Douglas-fir.	Black locust, Lombardy poplar.
32*: Chelan. (3 to 30 percent slopes)					
Chelan. (30 to 65 percent slopes)					
33*: Chelan. (30 to 65 percent slopes)					
Chelan. (3 to 30 percent slopes)					
34*: Condon----------	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, Rocky Mountain juniper.	Russian-olive, ponderosa pine.	Black locust------	---
Rock Creek.					
Broadax----------	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, Rocky Mountain juniper, blue spruce.	Russian-olive, green ash, Austrian pine, Scotch pine, ponderosa pine, Douglas-fir.	Black locust------	---
35*: Cordy. (3 to 30 percent slopes)					
Cordy. (30 to 55 percent slopes)					
36*: Cordy.					
Rock Creek.					
37. Dinkels					

See footnote at end of table.

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
38. Dougville					
39---------- Ellisforde	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Green ash, ponderosa pine, Austrian pine, blue spruce, Douglas-fir.	Black locust, Lombardy poplar.
40. Ellisforde					
41*: Ellisforde (15 to 30 percent slopes)					
Ellisforde. (30 to 60 percent slopes)					
42*: Entiat.					
Rock outcrop.					
43---------- Esquatzel	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, Rocky Mountain juniper, northern white-cedar.	Russian-olive-----	Green ash, ponderosa pine, Austrian pine, blue spruce, Douglas-fir.	Black locust, Lombardy poplar.
44. Finley					
45*, 46*. Haploxerolls					
47. Heytou					
48*: Kiona----------	---	---	---	---	---
Rubble land.					
49, 50---------- Magallon	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Green ash, ponderosa pine, Austrian pine, blue spruce, Douglas-fir.	Black locust, Lombardy poplar.
51, 52---------- Malaga	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Green ash, ponderosa pine, Austrian pine, blue spruce, Douglas-fir.	Black locust, Lombardy poplar.
53*. Pits					
54, 55, 56, 57, 58, 59, 60, 61--- Pogue	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Green ash, ponderosa pine, Austrian pine, blue spruce, Douglas-fir	Black locust, Lombardy poplar.

See footnote at end of table.

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
62, 63---------- Quincy	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, Nanking cherry, northern white-cedar, multiflora rose.	Russian-olive-----	Austrian pine, ponderosa pine, Scotch pine, Douglas-fir, green ash, blue spruce.	Lombardy poplar, Black locust.
64*: Ralls.					
Renslow.					
Bakeoven.					
65*: Renslow. (0 to 15 percent slopes)					
Dougville.					
Renslow. (15 to 30 percent slopes)					
66*: Renslow.					
Zen.					
67. Rock Creek					
68*: Rubble land.					
Rock outcrop.					
69---------- Umapine Variant	---	Southernwood------	Russian-olive, golden willow.	---	---
70. Strat					
71, 72---------- Supplee	Lilac, Nanking cherry, Tatarian honeysuckle.	Siberian peashrub, northern white-cedar.	Russian-olive-----	Green ash, ponderosa pine, Austrian pine, blue spruce, Douglas-fir.	Black locust, Lombardy poplar.
73---------- Timentwa	Nanking cherry----	Siberian peashrub, Rocky Mountain juniper.	Russian-olive, ponderosa pine, Austrian pine.	Black locust, green ash.	---
74. Touhey					
75. Willis					
76*. Xerofluvents					
77*. Xerorthents					

See footnote at end of table.

TABLE 10.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
78*:					
Zen.					
Bakeoven.					
Lickskillet.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
10*. Aquolls					
11---------- Badge	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope, small stones.	Severe: slope.	Severe: large stones, slope.
12*:					
Bakeoven----------	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones.	Severe: large stones, thin layer.
Lickskillet----------	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, slope, small stones.	Moderate: large stones, dusty.	Severe: thin layer.
13*:					
Bakeoven----------	Severe: large stones.	Severe: large stones.	Severe: large stones, slope, small stones.	Severe: large stones.	Severe: large stones, thin layer.
Touhey----------	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
14---------- Beverly	Severe: floods, small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.
15---------- Beverly	Severe: floods.	Moderate: large stones.	Severe: large stones.	Moderate: large stones.	Moderate: large stones, droughty.
16*:					
Broadax----------	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Slight.
Condon----------	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.	Moderate: thin layer.
17---------- Burbank	Slight----------	Slight----------	Moderate: slope, small stones.	Slight----------	Moderate: droughty.
18---------- Burbank	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
19---------- Burch	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
20---------- Burch	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.	Slight.
21---------- Burch	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Severe: erodes easily.	Slight.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
22--Cashmere	Slight	Slight	Slight	Slight	Slight.
23--Cashmere	Slight	Slight	Moderate: slope.	Slight	Slight.
24--Cashmere	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
25--Cashmont	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
26--Cashmont	Slight	Slight	Severe: small stones.	Slight	Moderate: small stones, droughty.
27--Cashmont	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight	Moderate: small stones, droughty.
28--Cashmont	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: small stones, slope.	Moderate: large stones.	Moderate: slope, large stones.
29--Cashmont Variant	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight	Slight.
30--Cashmont Variant	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
31--Chelan	Slight	Slight	Moderate: slope, small stones.	Severe: erodes easily.	Slight.
32*:					
Chelan (3 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Severe: erodes easily.	Severe: slope.
Chelan (30 to 65 percent slopes)	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Severe: slope, erodes easily.	Severe: slope.
33*:					
Chelan (30 to 65 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
Chelan (3 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
34*:					
Condon	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.	Moderate: thin layer.
Rock Creek	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: erodes easily.	Severe: large stones, droughty, slope.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
34*: Broadax	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Slight.
35*: Cordy (3 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Cordy (30 to 55 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
36*: Cordy	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
Rock Creek	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: erodes easily.	Severe: large stones, droughty, slope.
37--- Dinkels	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
38--- Dougville	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Slight.
39--- Ellisforde	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
40--- Ellisforde	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Slight.
41*: Ellisforde (15 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Ellisforde (30 to 60 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
42*: Entiat	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.	Severe: slope, thin layer.
Rock outcrop.					
43--- Esquatzel	Severe: floods.	Moderate: dusty.	Slight	Severe: erodes easily.	Slight.
44--- Finley	Slight	Slight	Moderate: slope, small stones.	Severe: erodes easily.	Moderate: droughty.
45*, 46*. Haploxerolls					
47--- Heytou	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Moderate: large stones, slope, dusty.	Severe: large stones, slope.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
48*: Kiona	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope, small stones.	Severe: large stones, slope, erodes easily.	Severe: slope, large stones.
Rubble land.					
49--- Magallon	Slight---	Slight---	Moderate: small stones, slope.	Slight---	Moderate: droughty.
50--- Magallon	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight---	Moderate: droughty, slope.
51--- Malaga	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight---	Moderate: small stones, droughty.
52--- Malaga	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Moderate: large stones.	Moderate: small stones, large stones.
53*. Pits					
54--- Pogue	Slight---	Slight---	Moderate: small stones.	Slight---	Moderate: droughty.
55--- Pogue	Slight---	Slight---	Moderate: slope, small stones.	Slight---	Moderate: droughty.
56--- Pogue	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight---	Moderate: droughty, slope.
57--- Pogue	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
58--- Pogue	Moderate: small stones.	Moderate: small stones.	Severe: large stones, slope, small stones.	Slight---	Moderate: large stones.
59--- Pogue	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: large stones, slope, small stones.	Moderate: large stones.	Severe: large stones.
60--- Pogue	Moderate: small stones.	Moderate: small stones.	Severe: large stones, small stones.	Slight---	Moderate: large stones.
61--- Pogue	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: dusty.	Moderate: droughty, slope.
62--- Quincy	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: slope.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
63--- Quincy	Slight	Slight	Severe: slope.	Slight	Moderate: droughty.
64*:					
Ralls	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
Renslow	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Bakeoven	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones.	Severe: large stones, thin layer.
65*:					
Renslow (0 to 15 percent slopes)	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Slight.
Dougville	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Slight.
Renslow (15 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
66*:					
Renslow	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Slight.
Zen	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Moderate: thin layer.
67--- Rock Creek	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: erodes easily.	Severe: large stones, droughty, slope.
68*:					
Rubble land.					
Rock outcrop.					
69--- Umapine Variant	Severe: floods.	Moderate: excess salt.	Moderate: excess salt.	Severe: erodes easily.	Moderate: excess salt.
70--- Strat	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: small stones, slope.	Moderate: large stones, dusty.	Moderate: slope, small stones.
71--- Supplee	Slight	Slight	Moderate: slope, small stones.	Severe: erodes easily.	Slight.
72--- Supplee	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
73--- Timentwa	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.	Slight.
74--- Touhey	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Moderate: thin layer.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
75---------- Willis	Moderate: slope, percs slowly, dusty.	Moderate: slope, percs slowly, dusty.	Severe: slope.	Severe: erodes easily.	Moderate: slope, thin layer.
76*. Xerofluvents					
77*. Xerorthents					
78*:					
Zen----------	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Moderate: thin layer.
Bakeoven----------	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones.	Severe: large stones, thin layer.
Lickskillet----------	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, slope, small stones.	Moderate: large stones, dusty.	Severe: thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
10*. Aquolls												
11---------- Badge	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
12*:												
Bakeoven----------	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Fair.
Lickskillet-------	Very poor.	Very poor.	Fair	---	---	Very poor.	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
13*:												
Bakeoven----------	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Fair.
Touhey----------	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
14---------- Beverly	Fair	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
15---------- Beverly	Poor	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
16*:												
Broadax----------	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Condon----------	Fair	Good	Good	---	---	Very poor.	Very poor.	Very poor.	Fair	---	Very poor.	Poor.
17---------- Burbank	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	---
18---------- Burbank	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair
19---------- Burch	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
20---------- Burch	Good	Good	Fair	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Fair.
21---------- Burch	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
22, 23, 24--------- Cashmere	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
25, 26, 27--------- Cashmont	Fair	Fair	Good	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Good.
28---------- Cashmont	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
29---------- Cashmont Variant	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	---	Very poor.	Good.
30---------- Cashmont Variant	Fair	Fair	Good	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Good.

See footnote at end of table.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
31---------- Chelan	Fair	Good	Good	---	Fair	Good	Poor	Very poor.	Good	---	Very poor.	Good.
32*:												
Chelan---------- (3 to 30 percent slopes)	Poor	Good	Good	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Good.
Chelan---------- (30 to 65 percent slopes)	Poor	Fair	Good	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Good.
33*:												
Chelan---------- (30 to 65 percent slopes)	Poor	Fair	Good	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Good.
Chelan---------- (3 to 30 percent slopes)	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
34*:												
Condon----------	Fair	Good	Good	---	---	Very poor.	Very poor.	Very poor.	Fair	---	Very poor.	Poor.
Rock Creek--------	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Broadax----------	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
35*:												
Cordy---------- (3 to 30 percent slopes)	Very poor.	Very poor.	Fair	---	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Cordy---------- (30 to 55 percent slopes)	Very poor.	Very poor.	Fair	---	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
36*:												
Cordy----------	Very poor.	Very poor.	Fair	---	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Rock Creek--------	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
37---------- Dinkels	Poor	Poor	Fair	---	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
38---------- Dougville	Fair	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
39---------- Ellisforde	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Good.
40---------- Ellisforde	Fair	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
41*:												
Ellisforde-------- (15 to 30 percent slopes)	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.

See footnote at end of table.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
41*:												
Ellisforde (30 to 60 percent slopes)	Very poor.	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
42*:												
Entiat	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Rock outcrop.												
43---- Esquatzel	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	---	Very poor.	Fair.
44---- Finley	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
45*, 46*. Haploxerolls												
47---- Heytou	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
48*:												
Kiona	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Rubble land.												
49, 50---- Magallon	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
51, 52---- Malaga	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
53*. Pits												
54, 55, 56, 57---- Pogue	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
58, 59, 60---- Pogue	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
61---- Pogue	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
62---- Quincy	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
63---- Quincy	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
64*:												
Ralls	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Renslow	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
Bakeoven	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Fair.

See footnote at end of table.

TABLE 12.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
65*:												
Renslow (0 to 15 percent slopes)	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
Dougville	Fair	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Renslow (15 to 30 percent slopes)	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
66*:												
Renslow	Fair	Good	Good	---	---	Good	Very poor.	Very poor.	Good	---	Very poor.	Good.
Zen	Fair	Good	Fair	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
67--- Rock Creek	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
68*:												
Rubble land.												
Rock outcrop.												
69--- Umapine Variant	Poor	Poor	Very poor.	---	---	Very poor.	Fair	Good	Poor	---	Good	Very poor.
70--- Strat	Poor	Poor	Fair	---	---	Fair	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
71, 72. Supplee												
73--- Timentwa	Fair	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Fair.
74. Touhey												
75--- Willis	Fair	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
76*. Xerofluvents												
77*. Xerorthents												
78*:												
Zen	Fair	Good	Fair	---	---	Good	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Bakeoven	Very poor.	Very poor.	Fair	---	---	Fair	Very poor.	Very poor.	Very poor.	---	Very poor.	Fair.
Lickskillet	Very poor.	Very poor.	Fair	---	---	Very poor.	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
10*. Aquolls						
11---------- Badge	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.
12*: Bakeoven---------	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, thin layer.
Lickskillet------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: thin layer.
13*: Bakeoven---------	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, thin layer.
Touhey----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Moderate: slope.	Moderate: frost action.	Moderate: slope.
14---------- Beverly	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.	Severe: small stones.
15---------- Beverly	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, large stones.	Moderate: large stones, droughty.
16*: Broadax----------	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
Condon----------	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: frost action.	Moderate: thin layer.
17---------- Burbank	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Moderate: droughty.
18---------- Burbank	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
19---------- Burch	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
20---------- Burch	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
21---------- Burch	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.

See footnote at end of table.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
22---------- Cashmere	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
23---------- Cashmere	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
24---------- Cashmere	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
25---------- Cashmont	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
26---------- Cashmont	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Moderate: small stones, droughty.
27---------- Cashmont	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: small stones, droughty.
28---------- Cashmont	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope, large stones.
29---------- Cashmont Variant	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
30---------- Cashmont Variant	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
31---------- Chelan	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
32*:						
Chelan---------- (3 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Chelan---------- (30 to 65 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
33*:						
Chelan---------- (30 to 65 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Chelan---------- (3 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
34*:						
Condon----------	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: frost action.	Moderate: thin layer.
Rock Creek-------	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones, droughty, slope.
Broadax----------	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.

See footnote at end of table.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
35*:						
Cordy (3 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Cordy (30 to 55 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
36*:						
Cordy	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock Creek	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones, droughty, slope.
37--- Dinkels	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
38--- Dougville	Slight---	Slight---	Slight---	Moderate: slope.	Moderate: frost action.	Slight.
39, 40--- Ellisforde	Slight---	Slight---	Slight---	Moderate: slope.	Moderate: frost action.	Slight.
41*:						
Ellisforde (15 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ellisforde (30 to 60 slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
42*:						
Entiat	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Rock outcrop.						
43--- Esquatzel	Slight---	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, frost action.	Slight.
44--- Finley	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
45*, 46*. Haploxerolls						
47--- Heytou	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: large stones, slope.
48*:						
Kiona	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, large stones.
Rubble land.						
49--- Magallon	Severe: cutbanks cave.	Slight---	Slight---	Moderate: slope.	Slight---	Moderate: droughty.

See footnote at end of table.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
50---- Magallon	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
51---- Malaga	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Moderate: small stones, droughty.
52---- Malaga	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: large stones.	Moderate: small stones, large stones, droughty.
53*. Pits						
54---- Pogue	Severe: cutbanks cave.	Slight----------	Slight----------	Slight----------	Moderate: frost action.	Moderate: droughty.
55---- Pogue	Severe: cutbanks cave.	Slight----------	Slight----------	Moderate: slope.	Moderate: frost action.	Moderate: droughty.
56---- Pogue	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
57---- Pogue	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
58---- Pogue	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: frost action, large stones.	Moderate: large stones.
59---- Pogue	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, frost action, large stones.	Severe: large stones.
60---- Pogue	Severe: cutbanks cave.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: frost action, large stones.	Moderate: large stones.
61---- Pogue	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: droughty, slope.
62---- Quincy	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
63---- Quincy	Severe: cutbanks cave.	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.
64*:						
Ralls----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Renslow----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
Bakeoven---------	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, thin layer.

See footnote at end of table.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
65*:						
Renslow (0 to 15 percent slopes)	Slight	Slight	Slight	Moderate: slope.	Severe: frost action.	Slight.
Dougville	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
Renslow (15 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.
66*:						
Renslow	Slight	Slight	Slight	Moderate: slope.	Severe: frost action.	Slight.
Zen	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, low strength.	Moderate: thin layer.
67--- Rock Creek	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones, droughty, slope.
68*:						
Rubble land.						
Rock outcrop.						
69--- Umapine Variant	Severe: wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Moderate: floods, frost action.	Moderate: excess salt, thin layer.
70--- Strat	Severe: cutbanks cave.	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: slope, frost action, large stones.	Moderate: slope, small stones.
71--- Supplee	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
72--- Supplee	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
73--- Timentwa	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
74--- Touhey	Moderate: slope.	Moderate: slope.	Moderate: slope.	Moderate: slope.	Moderate: frost action.	Moderate: slope.
75--- Willis	Severe: cemented pan.	Moderate: slope, cemented pan.	Severe: cemented pan.	Severe: slope.	Moderate: cemented pan, slope, frost action.	Moderate: slope, thin layer.
76*. Xerofluvents						
77*. Xerorthents						

See footnote at end of table.

TABLE 13.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
78*:						
Zen	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, low strength.	Moderate: thin layer.
Bakeoven	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, thin layer.
Lickskillet	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
10* Aquolls					
11---------- Badge	Severe: percs slowly, slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope.	Poor: small stones, slope.
12*:					
Bakeoven----------	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: small stones, area reclaim.
Lickskillet--------	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, small stones.
13*:					
Bakeoven----------	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: small stones, area reclaim.
Touhey----------	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
14---------- Beverly	Severe: poor filter.	Severe: seepage, floods.	Severe: too sandy.	Moderate: floods.	Poor: seepage, too sandy, small stones.
15---------- Beverly	Severe: poor filter.	Severe: seepage, floods.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
16*:					
Broadax----------	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight----------	Good.
Condon----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
17---------- Burbank	Severe: poor filter.	Severe: seepage.	Severe: too sandy, large stones.	Slight----------	Poor: seepage, too sandy, small stones.
18---------- Burbank	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy, large stones.	Severe: slope.	Poor: seepage, too sandy, small stones.
19---------- Burch	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.

See footnote at end of table.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
20---------- Burch	Moderate: percs slowly.	Moderate: seepage.	Slight----------	Slight----------	Good.
21---------- Burch	Moderate: percs slowly.	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
22, 23---------- Cashmere	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
24---------- Cashmere	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
25, 26---------- Cashmont	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: small stones.
27, 28---------- Cashmont	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: small stones.
29---------- Cashmont Variant	Severe: percs slowly.	Moderate: seepage, slope.	Slight----------	Slight----------	Poor: small stones.
30---------- Cashmont Variant	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
31---------- Chelan	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Slight----------	Fair: small stones, thin layer.
32*:					
Chelan---------- (3 to 30 percent slopes)	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Chelan---------- (30 to 65 percent slopes)	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
33*:					
Chelan---------- (30 to 65 percent slopes)	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Chelan---------- (3 to 30 percent slopes)	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
34*:					
Condon----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Rock Creek---------	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, small stones.
Broadax----------	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight----------	Good.

See footnote at end of table.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
35*:					
Cordy (3 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Cordy (30 to 55 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
36*:					
Cordy	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Rock Creek	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, small stones.
37--- Dinkels	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope.
38--- Dougville	Moderate: percs slowly.	Severe: slope.	Slight	Slight	Good.
39--- Ellisforde	Severe: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
40--- Ellisforde	Severe: percs slowly.	Severe: slope.	Slight	Slight	Good.
41*:					
Ellisforde (15 to 30 percent slopes)	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Ellisforde (30 to 60 percent slopes)	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
42*:					
Entiat	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
Rock outcrop.					
43--- Esquatzel	Moderate: floods, percs slowly.	Severe: floods.	Moderate: floods.	Moderate: floods.	Good.
44--- Finley	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
45*, 46*. Haploxerolls					
47--- Heytou	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: slope.	Poor: small stones, slope.

See footnote at end of table.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
48*: Kiona	Severe: slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope.	Poor: large stones, slope.
Rubble land.					
49 Magallon	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
50 Magallon	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
51, 52 Malaga	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight	Poor: seepage, too sandy, small stones.
53*. Pits					
54, 55 Pogue	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
56 Pogue	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
57 Pogue	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
58 Pogue	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
59 Pogue	Severe: poor filter.	Severe: seepage, slope, large stones.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
60 Pogue	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
61 Pogue	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
62 Quincy	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: too sandy, slope.
63 Quincy	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy.	Slight	Poor: too sandy.

See footnote at end of table.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
64*:					
Ralls	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
Renslow	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Bakeoven	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: small stones, area reclaim.
65*:					
Renslow (0 to 15 percent slopes)	Moderate: percs slowly.	Severe: slope.	Slight	Slight	Good.
Dougville	Moderate: percs slowly.	Severe: slope.	Slight	Slight	Good.
Renslow (15 to 30 percent slopes)	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
66*:					
Renslow	Moderate: percs slowly.	Severe: slope.	Slight	Slight	Good.
Zen	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
67 Rock Creek	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, small stones.
68*:					
Rubble land.					
Rock outcrop.					
69 Umapine Variant	Severe: cemented pan, percs slowly.	Severe: cemented pan, floods, wetness.	Severe: cemented pan.	Severe: cemented pan.	Poor: area reclaim.
70 Strat	Severe: poor filter.	Severe: seepage, slope, large stones.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
71 Supplee	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
72 Supplee	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
73 Timentwa	Severe: percs slowly.	Severe: slope.	Moderate: cemented pan.	Moderate: cemented pan.	Fair: area reclaim, small stones.

See footnote at end of table.

TABLE 14.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
74---------- Touhey	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
75---------- Willis	Severe: cemented pan, percs slowly.	Severe: cemented pan, slope.	Severe: cemented pan.	Severe: cemented pan.	Poor: area reclaim.
76*. Xerofluvents					
77*. Xerorthents					
78*: Zen----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Bakeoven----------	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: small stones, area reclaim.
Lickskillet--------	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
10*. Aquolls				
11--- Badge	Poor: large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: small stones, area reclaim, slope.
12*:				
Bakeoven---	Poor: area reclaim, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
Lickskillet---	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
13*:				
Bakeoven---	Poor: area reclaim, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
Touhey---	Good---	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
14--- Beverly	Good---	Probable---	Probable---	Poor: small stones, area reclaim.
15--- Beverly	Fair: large stones.	Probable---	Probable---	Poor: small stones, area reclaim.
16*:				
Broadax---	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Condon---	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
17--- Burbank	Fair: large stones.	Probable---	Probable---	Poor: small stones, area reclaim.
18--- Burbank	Fair: large stones, slope.	Probable---	Probable---	Poor: small stones, area reclaim.
19--- Burch	Good---	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
20, 21--- Burch	Good---	Improbable: excess fines.	Improbable: excess fines.	Good.
22, 23--- Cashmere	Good---	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
24--- Cashmere	Good---	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.

See footnote at end of table.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
25, 26, 27, 28-------- Cashmont	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
29, 30---------- Cashmont Variant	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
31---------- Chelan	Good----------	Probable----------	Probable----------	Poor: area reclaim.
32*: Chelan---------- (3 to 30 percent slopes)	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Chelan---------- (30 to 65 percent slopes)	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
33*: Chelan---------- (30 to 65 percent slopes)	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Chelan---------- (3 to 30 percent slopes)	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
34*: Condon----------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
Rock Creek----------	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, small stones, slope.
Broadax----------	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
35*: Cordy---------- (3 to 30 percent slopes)	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Cordy---------- (30 to 55 percent slopes)	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
36*: Cordy----------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Rock Creek----------	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, small stones, slope.
37---------- Dinkels	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.

See footnote at end of table.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
38---------- Dougville	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
39, 40---------- Ellisforde	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
41*: Ellisforde---------- (15 to 30 percent slopes)	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Ellisforde---------- (30 to 60 percent slopes)	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
42*: Entiat----------	Poor: area reclaim, thin layer, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
43---------- Esquatzel	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
44---------- Finley	Good----------	Improbable: small stones.	Probable----------	Poor: small stones, area reclaim.
45*, 46*. Haploxerolls				
47---------- Heytou	Fair: large stones, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
48*: Kiona----------	Poor: slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, small stones, slope.
Rubble land.				
49, 50---------- Magallon	Good----------	Probable----------	Improbable: too sandy.	Poor: thin layer.
51, 52---------- Malaga	Fair: large stones.	Probable----------	Probable----------	Poor: small stones, area reclaim.
53*. Pits				
54, 55, 56---------- Pogue	Good----------	Probable----------	Probable----------	Poor: small stones, area reclaim.
57---------- Pogue	Fair: slope.	Probable----------	Probable----------	Poor: small stones, area reclaim, slope.

See footnote at end of table.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
58, 59, 60---------- Pogue	Fair: large stones.	Probable----------	Probable----------	Poor: small stones, area reclaim.
61---------- Pogue	Good----------	Probable----------	Probable----------	Poor: small stones, area reclaim.
62---------- Quincy	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, slope.
63---------- Quincy	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
64*:				
Ralls----------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Renslow----------	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Bakeoven----------	Poor: area reclaim, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
65*:				
Renslow---------- (0 to 15 percent slopes)	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
Dougville----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
Renslow---------- (15 to 30 percent slopes)	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
66*:				
Renslow----------	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
Zen----------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
67---------- Rock Creek	Poor: area reclaim, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, small stones, slope.
68*:				
Rubble land.				
Rock outcrop.				
69---------- Umapine Variant	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, excess salt, thin layer.
70---------- Strat	Fair: large stones.	Probable----------	Probable----------	Poor: small stones, area reclaim.

See footnote at end of table.

TABLE 15.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
71, 72---------- Supplee	Good----------	Probable----------	Probable----------	Poor: small stones, area reclaim.
73---------- Timentwa	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
74---------- Touhey	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
75---------- Willis	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer, slope.
76*. Xerofluvents				
77*. Xerorthents				
78*: Zen----------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
Bakeoven----------	Poor: area reclaim, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
Lickskillet----------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
10*. Aquolls						
11---------- Badge	Severe: slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
12*:						
Bakeoven---------	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Deep to water	Depth to rock, slope.	Slope, depth to rock, large stones.	Large stones, slope, droughty.
Lickskillet------	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
13*:						
Bakeoven---------	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Deep to water	Depth to rock, slope.	Slope, depth to rock, large stones.	Large stones, slope, droughty.
Touhey-----------	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
14---------- Beverly	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing.	Large stones, too sandy, soil blowing.	Large stones, droughty.
15---------- Beverly	Severe: seepage.	Severe: seepage.	Deep to water	Large stones, droughty, soil blowing.	Large stones, too sandy, soil blowing.	Large stones, droughty.
16*:						
Broadax----------	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
Condon-----------	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
17---------- Burbank	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Large stones, too sandy.	Large stones, droughty.
18---------- Burbank	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Slope, large stones, too sandy.	Large stones, slope, droughty.
19---------- Burch	Severe: slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope----------	Slope.
20---------- Burch	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
21---------- Burch	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
22---------- Cashmere	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing---	Erodes easily, soil blowing.	Erodes easily.
23---------- Cashmere	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Erodes easily, soil blowing.	Erodes easily.
24---------- Cashmere	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope.	Slope, erodes easily, soil blowing.	Slope, erodes easily.
25---------- Cashmont	Severe: seepage.	Moderate: seepage, piping.	Deep to water	Droughty, soil blowing, slope.	Soil blowing---	Droughty.
26---------- Cashmont	Severe: seepage.	Moderate: seepage, piping.	Deep to water	Droughty, slope.	Favorable------	Droughty.
27, 28---------- Cashmont	Severe: seepage, slope.	Moderate: sepage, piping.	Deep to water	Droughty, slope.	Slope----------	Slope, droughty.
29---------- Cashmont Variant	Moderate: slope.	Severe: seepage.	Deep to water	Soil blowing, slope.	Soil blowing---	Favorable.
30---------- Cashmont Variant	Severe: slope.	Severe: seepage.	Deep to water	Soil blowing, slope.	Slope, soil blowing.	Slope.
31---------- Chelan	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Large stones,	Erodes easily.
32*:						
Chelan---------- (3 to 30 percent slopes)	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, large stones, erodes easily.	Slope, erodes easily.
Chelan---------- (30 to 65 percent slopes)	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, large stones, erodes easily.	Slope, erodes easily.
33*:						
Chelan---------- (30 to 65 percent slopes)	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, large stones, erodes easily.	Slope, erodes easily.
Chelan---------- (3 to 30 percent slopes)	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, large stones, erodes easily.	Slope, erodes easily.
34*:						
Condon----------	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Rock Creek-------	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, erodes easily.
Broadax----------	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
35*:						
Cordy (3 to 30 percent slopes)	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Cordy (30 to 55 percent slopes)	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
36*:						
Cordy	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Rock Creek	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, erodes easily.
37--- Dinkels	Severe: slope.	Moderate: thin layer, seepage, piping.	Deep to water	Droughty, slope.	Slope	Slope, droughty.
38--- Dougville	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
39--- Ellisforde	Moderate: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, slope, erodes easily.	Erodes easily, soil blowing.	Erodes easily.
40--- Ellisforde	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
41*:						
Ellisforde (15 to 30 percent slopes)	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Ellisforde (30 to 60 percent slopes)	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
42*:						
Entiat	Severe: depth to rock, slope.	Severe: seepage.	Deep to water	Droughty, depth to rock, slope.	Slope, depth to rock.	Slope, droughty, depth to rock.
Rock outcrop.						
43--- Esquatzel	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
44--- Finley	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Large stones, erodes easily.	Large stones, erodes easily, droughty.
45*, 46*. Haploxerolls						
47--- Heytou	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.

See footnote at end of table.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
48*:						
Kiona	Severe: slope.	Severe: seepage, large stones.	Deep to water	Large stones, slope, erodes easily.	Slope, large stones, erodes easily.	Large stones, slope, erodes easily.
Rubble land.						
49---- Magallon	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy------	Droughty.
50---- Magallon	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Slope, too sandy.	Slope, droughty.
51, 52---- Malaga	Severe: seepage.	Severe: seepage.	Deep to water	Large stones, droughty.	Large stones, too sandy.	Large stones, droughty.
53*. Pits						
54---- Pogue	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing.	Large stones, too sandy.	Large stones, droughty.
55---- Pogue	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Large stones, too sandy.	Large stones, droughty.
56, 57---- Pogue	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, slope.	Slope, large stones, too sandy.	Large stones, slope, droughty.
58---- Pogue	Severe: seepage.	Severe: seepage.	Deep to water	Large stones, droughty, slope.	Large stones, too sandy.	Large stones, droughty.
59---- Pogue	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones, too sandy.	Large stones, slope, droughty.
60---- Pogue	Severe: seepage.	Severe: seepage.	Deep to water	Large stones, droughty, slope.	Large stones, too sandy.	Large stones, droughty.
61---- Pogue	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, slope.	Slope, large stones, too sandy.	Large stones, slope, droughty.
62---- Quincy	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
63---- Quincy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
64*:						
Ralls	Severe: slope.	Slight---------	Deep to water	Slope----------	Slope, large stones.	Large stones, slope.
Renslow	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Bakeoven	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Deep to water	Depth to rock, slope.	Slope, depth to rock, large stones.	Large stones, slope, droughty.

See footnote at end of table.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
65*:						
Renslow (0 to 15 percent slopes)	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
Dougville	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
Renslow (15 to 30 percent slopes)	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
66*:						
Renslow	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
66*:						
Zen	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
67 Rock Creek	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, erodes easily.
68*:						
Rubble land.						
Rock outcrop.						
69 Umapine Variant	Moderate: seepage, cemented pan.	Severe: piping.	Cemented pan	Wetness, cemented pan, erodes easily.	Cemented pan, erodes easily, wetness.	Excess salt, erodes easily, cemented pan.
70 Strat	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones, too sandy.	Large stones, slope, droughty.
71 Supplee	Severe: seepage.	Severe: seepage.	Deep to water	Slope, erodes easily, soil blowing.	Large stones, erodes easily.	Large stones, erodes easily.
72 Supplee	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, erodes easily, soil blowing.	Slope, large stones, erodes easily.	Large stones, slope, erodes easily.
73 Timentwa	Moderate: seepage, cemented pan, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
74 Touhey	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
75 Willis	Severe: slope.	Severe: piping.	Deep to water	Percs slowly, cemented pan, slope.	Slope, cemented pan, erodes easily.	Slope, erodes easily, cemented pan.
76*. Xerofluvents						
77*. Xerorthents						

See footnote at end of table.

TABLE 16.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
78*:						
Zen	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope, erodes easily.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Bakeoven	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Deep to water	Depth to rock, slope.	Slope, depth to rock, large stones.	Large stones, slope, droughty.
Lickskillet	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
10*. Aquolls											
11---------- Badge	0-13	Very cobbly silt loam.	GM, ML	A-4	30-50	55-75	50-70	45-65	35-60	25-35	NP-5
	13-28	Extremely cobbly clay loam, very cobbly loam, very gravelly silt loam.	GC	A-2	30-60	40-50	30-40	15-35	15-30	30-45	10-20
	28-60	Very cobbly silt loam, very cobbly clay loam, very gravelly loam.	GM	A-4, A-2, A-1	30-60	50-60	30-50	20-40	15-40	25-35	NP-5
12*:											
Bakeoven--------	0-4	Very cobbly loam	GM	A-2, A-4	35-60	50-70	40-65	35-55	30-50	25-35	NP-10
	4-9	Very gravelly clay loam, very gravelly silt loam, very gravelly loam.	GM	A-4	5-55	50-65	45-60	40-55	35-50	30-40	5-10
	9	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Lickskillet-----	0-4	Cobbly silt loam	CL-ML, ML	A-4	10-30	70-95	60-80	55-75	50-65	25-35	5-10
	4-18	Very gravelly clay loam, very gravelly silt loam, very cobbly loam.	GC	A-2, A-6, A-7	15-50	40-65	25-50	20-50	15-40	35-45	15-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
13*:											
Bakeoven--------	0-4	Very cobbly loam	GM	A-2, A-4	35-60	50-70	40-65	35-55	30-50	25-35	NP-10
	4-9	Very gravelly clay loam, very cobbly loam, very gravelly loam.	GM	A-4	5-55	50-65	45-60	40-55	35-50	30-40	5-10
	9	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Touhey----------	0-10	Loam----------	ML	A-4	0-5	95-100	95-100	70-85	60-70	20-30	NP-5
	10-28	Gravelly loam, gravelly fine sandy loam, loam.	ML	A-4	5-10	85-95	70-80	65-75	50-60	20-30	NP-5
	28-60	Gravelly loam, cobbly loam.	SM	A-4	5-20	70-80	55-75	55-65	40-50	20-30	NP-5

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
14---------- Beverly	0-5	Fine sandy loam	SM	A-4	0	95-100	85-95	75-85	40-50	20-30	NP-5
	5-20	Gravelly fine sandy loam, very gravelly sandy loam, gravelly loamy sand.	GM, SM	A-1, A-2	0-20	40-80	30-70	25-60	10-35	20-30	NP-5
	20-60	Extremely gravelly sand, extremely gravelly loamy coarse sand, extremely gravelly loamy sand.	GP	A-1	5-30	20-35	10-25	5-20	0-5	---	NP
15---------- Beverly	0-5	Cobbly fine sandy loam.	SM	A-4	20-30	85-95	80-90	70-85	35-50	20-30	NP-5
	5-20	Gravelly fine sandy loam, very gravelly sandy loam, gravelly loamy sand.	GM, SM	A-1, A-2, A-4	0-20	40-80	30-70	25-60	10-45	20-30	NP-5
	20-60	Extremely gravelly sand, extremely gravelly loamy coarse sand, extremely gravelly loamy sand.	GP	A-1	5-30	20-35	10-25	5-20	0-5	---	NP
16*:											
Broadax----------	0-13	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	75-95	25-35	NP-10
	13-35	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	85-95	30-40	10-15
	35-60	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	75-95	25-35	NP-10
Condon----------	0-7	Silt loam--------	ML, CL-ML	A-4	0	100	95-100	90-100	80-90	25-35	5-10
	7-34	Silt loam--------	ML, CL-ML	A-4	0	100	100	90-100	80-90	25-35	5-10
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
17, 18---------- Burbank	0-6	Loamy fine sand	SM	A-2	0-5	95-100	80-95	60-80	15-35	---	NP
	6-20	Loamy sand, loamy fine sand, gravelly loamy fine sand.	SM	A-2	0-5	85-95	70-90	60-80	15-35	---	NP
	20-60	Very gravelly sand, extremely cobbly coarse sand.	GP	A-1	35-50	35-45	45-55	5-15	0-5	---	NP
19---------- Burch	0-10	Fine sandy loam	SM, ML	A-4	0	95-100	90-95	70-85	40-55	20-30	NP-5
	10-60	Loam, very fine sandy loam, silt loam.	ML	A-4	0	95-100	90-100	80-90	60-75	25-35	NP-10
20, 21---------- Burch	0-10	Loam----------	ML	A-4	0	100	90-100	75-85	60-75	20-30	NP-5
	10-60	Loam, very fine sandy loam, silt loam.	ML	A-4	0	95-100	90-100	80-90	60-75	25-35	NP-10

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
22, 23, 24------- Cashmere	0-11	Fine sandy loam	SM	A-4, A-2	0	95-100	90-100	50-75	30-45	20-30	NP-5
	11-60	Fine sandy loam, coarse sandy loam, very fine sandy loam.	SM	A-2, A-4	0-5	80-100	80-100	50-65	20-40	20-30	NP-5
25--------------- Cashmont	0-21	Sandy loam-------	SM	A-2, A-4	0	85-100	75-90	60-65	30-45	20-30	NP-5
	21-28	Gravelly sandy loam, gravelly fine sandy loam, gravelly coarse sandy loam.	GM, SM	A-1, A-2	0-10	60-80	50-75	25-55	20-35	20-30	NP-5
	28-60	Gravelly sandy loam, gravelly fine sandy loam, gravelly coarse sandy loam.	GM, SM	A-1, A-2	0-10	60-80	50-75	25-55	20-35	20-30	NP-5
26, 27----------- Cashmont	0-21	Gravelly sandy loam.	SM	A-1, A-2	0	60-85	50-75	30-45	20-35	20-30	NP-5
	21-28	Gravelly sandy loam, gravelly fine sandy loam, gravelly coarse sandy loam.	GM, SM	A-1, A-2	0-10	60-80	50-75	25-55	20-35	20-30	NP-5
	28-60	Gravelly sandy loam, gravelly fine sandy loam, gravelly coarse sandy loam.	GM, SM	A-1, A-2	0-10	60-80	50-75	25-55	20-35	20-30	NP-5
28--------------- Cashmont	0-21	Cobbly sandy loam	SM	A-1, A-2	10-30	80-90	70-85	45-55	20-30	20-30	NP-5
	21-28	Gravelly sandy loam, gravelly fine sandy loam, gravelly coarse sandy loam.	GM, SM	A-1, A-2	0-10	60-80	50-75	25-55	20-35	20-30	NP-5
	28-60	Gravelly sandy loam, gravelly fine sandy loam, gravelly coarse sandy loam.	GM, SM	A-1, A-2	0-10	60-80	50-75	25-55	20-35	20-30	NP-5
29, 30----------- Cashmont Variant	0-12	Fine sandy loam	SM, ML	A-4	0	85-100	80-95	55-75	45-60	20-30	NP-5
	12-20	Loam, fine sandy loam.	ML, SM	A-4	0	80-95	75-90	50-75	40-60	20-30	NP-5
	20-60	Very gravelly loam, extremely gravelly loam.	GM	A-1, A-2	0-15	30-50	15-45	10-35	10-30	20-30	NP-5
31--------------- Chelan	0-9	Very fine sandy loam.	SM, ML	A-4	0-5	85-100	75-100	60-85	35-60	30-40	NP-5
	9-22	Sandy loam, very fine sandy loam, loam.	SM, ML	A-4, A-2	0-5	85-100	75-100	60-85	30-60	30-40	NP-5
	22-50	Fine sandy loam, sandy loam, very fine sandy loam.	SM, ML	A-4, A-2	0-5	85-100	75-100	60-85	30-60	30-40	NP-5
	50-60	Extremely cobbly sand.	GP	A-1	25-65	25-35	10-20	5-10	0-5	---	NP-5

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
32*:											
Chelan----------	0-10	Bouldery very fine sandy loam.	SM	A-4, A-2	10-25	85-100	80-100	60-85	30-50	20-30	NP-5
(3 to 30 percent slopes)	10-25	Sandy loam, very fine sandy loam, loam.	SM, ML	A-4, A-2	0-5	85-100	75-100	60-85	30-60	30-40	NP-5
	25-46	Fine sandy loam, sandy loam, very fine sandy loam.	SM	A-4, A-2	0-5	85-100	75-100	60-85	30-50	30-40	NP-5
	46-60	Cobbly sandy loam, very cobbly sandy loam, gravelly loam.	SM	A-1	20-50	65-75	60-70	35-45	20-25	20-30	NP-5
Chelan----------	0-10	Bouldery very fine sandy loam.	SM	A-4, A-2	10-25	85-100	80-100	60-85	30-50	20-30	NP-5
(30 to 65 percent slopes)	10-25	Fine sandy loam, very fine sandy loam, loam.	SM, ML	A-4, A-2	0-5	85-100	75-100	60-85	30-60	30-40	NP-5
	25-46	Fine sandy loam, sandy loam, very fine sandy loam.	SM	A-4, A-2	0-5	85-100	75-100	60-85	30-50	30-40	NP-5
	46-60	Cobbly sandy loam, very cobbly sandy loam, gravelly loam.	SM	A-1	20-50	65-75	60-70	35-45	20-25	20-30	NP-5
33*:											
Chelan----------	0-10	Loam----------	ML	A-4	0-5	85-100	75-100	60-90	50-70	30-40	NP-5
(30 to 65 percent slopes)	10-25	Very fine sandy loam, loam, gravelly sandy loam.	SM, ML	A-4, A-2	0-5	80-100	65-100	60-85	30-60	30-40	NP-5
	25-46	Very fine sandy loam, fine sandy loam, gravelly sandy loam.	SM, ML	A-4, A-2	0-5	80-100	65-100	60-85	30-60	30-40	NP-5
	46-60	Cobbly sandy loam, very cobbly sandy loam, gravelly loam.	SM	A-1, A-2	20-50	65-75	60-70	35-45	20-30	20-30	NP-5
Chelan----------	0-10	Loam----------	ML	A-4	0-5	85-100	75-100	60-90	50-70	30-40	NP-5
(3 to 30 percent slopes)	10-25	Very fine sandy loam, loam, gravelly sandy loam.	SM, ML	A-4, A-2	0-5	80-100	65-100	60-85	30-60	30-40	NP-5
	25-46	Very fine sandy loam, fine sandy loam, gravelly sandy loam.	SM, ML	A-4, A-2	0-5	80-100	65-100	60-85	30-60	30-40	NP-5
	46-60	Cobbly sandy loam, very cobbly sandy loam, gravelly loam.	SM	A-1, A-2	20-50	65-75	60-70	35-45	20-30	20-30	NP-5
34*:											
Condon----------	0-7	Silt loam--------	ML, CL-ML	A-4	0	100	95-100	90-100	80-90	25-35	5-10
	7-34	Silt loam--------	ML, CL-ML	A-4	0	100	100	90-100	80-90	25-35	5-10
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
34*:											
Rock Creek------	0-3	Very cobbly silt loam.	ML, GM	A-4	30-45	60-75	50-65	45-60	40-55	20-30	NP-5
	3-12	Very gravelly clay loam, extremely cobbly clay, very gravelly clay.	GM	A-2, A-7	15-70	35-70	20-50	20-45	20-40	40-50	10-20
	12	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Broadax---------	0-13	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	75-95	25-35	NP-10
	13-35	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	85-95	30-40	10-15
	35-60	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	75-95	25-35	NP-10
35*:											
Cordy-----------	0-12	Loam-------------	ML	A-4	0	100	95-100	90-100	70-90	30-40	5-10
(3 to 30	12-40	Loam, silt loam	ML	A-4	0	100	95-100	90-100	70-85	30-40	5-10
percent slopes)	40-60	Silt loam, loam	ML, CL-ML	A-4	0-10	90-100	85-95	75-95	65-80	25-35	5-10
Cordy-----------	0-12	Loam-------------	ML	A-4	0	100	95-100	90-100	70-90	30-40	5-10
(30 to 55	12-40	Loam, silt loam	ML	A-4	0	100	95-100	90-100	70-85	30-40	5-10
percent slopes)	40-60	Silt loam, loam	ML, CL-ML	A-4	0-10	90-100	85-95	75-95	65-80	25-35	5-10
36*:											
Cordy-----------	0-12	Loam-------------	ML	A-4	0	100	95-100	90-100	70-90	30-40	5-10
	12-40	Loam, silt loam	ML	A-4	0	100	95-100	90-100	70-85	30-40	5-10
	40-60	Silt loam, loam	ML, CL-ML	A-4	0-10	90-100	85-95	75-95	65-80	25-35	5-10
Rock Creek------	0-3	Very cobbly silt loam.	ML, GM	A-4	30-45	60-75	50-65	45-60	40-55	20-30	NP-5
	3-12	Very gravelly clay loam, extremely cobbly clay, very gravelly clay.	GM	A-2, A-7	15-70	35-70	20-50	20-45	20-40	40-50	10-20
	12	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
37---------------	0-13	Gravelly loam----	SM, ML	A-4	0-15	80-90	60-75	50-70	40-60	15-25	NP-5
Dinkels	13-24	Gravelly coarse sandy loam, gravelly sandy loam, gravelly loam.	SM	A-2, A-4	0-10	80-90	60-75	30-60	25-50	15-25	NP-5
	24-43	Very gravelly coarse sandy loam.	SM	A-1	5-25	75-90	40-55	25-40	10-20	---	NP
	43	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
38---------------	0-9	Loam-------------	ML	A-4	0	100	95-100	80-95	60-70	30-40	NP-5
Dougville	9-42	Loam, silt loam	ML	A-4	0	100	95-100	80-95	60-75	30-40	NP-5
	42-60	Silt loam--------	ML	A-4	0	100	100	90-100	80-95	25-35	NP-10
39---------------	0-12	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	40-55	20-30	NP-5
Ellisforde	12-27	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
	27-60	Stratified silt loam to very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
40----------	0-12	Loam----------	ML	A-4	0	100	100	85-100	60-90	20-30	NP-5
Ellisforde	12-27	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
	27-60	Stratified silt loam to very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
41*:											
Ellisforde------ (15 to 30 percent slopes)	0-12	Loam----------	ML	A-4	0	100	100	85-100	60-90	20-30	NP-5
	12-27	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
	27-60	Stratified silt loam to very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
Ellisforde------ (30 to 60 percent slopes)	0-12	Loam----------	ML	A-4	0	100	100	85-100	60-90	20-30	NP-5
	12-27	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
	27-60	Stratified silt loam to very fine sandy loam.	ML	A-4	0	100	100	95-100	85-95	20-30	NP-5
42*:											
Entiat----------	0-6	Gravelly fine sandy loam.	SM, GM	A-2, A-1	0-10	60-80	50-75	40-60	20-35	20-30	NP-5
	6-11	Very gravelly loam, very gravelly sandy loam.	SM	A-1, A-2	0-15	70-80	35-45	25-40	15-35	20-30	NP-5
	11-17	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	SM	A-1	0-15	60-70	25-45	15-35	10-25	20-30	NP-5
	17	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop.											
43----------	0-10	Loam----------	ML	A-4	0	100	100	90-100	75-90	20-30	NP-5
Esquatzel	10-34	Silt loam--------	ML	A-4	0	100	100	95-100	80-95	20-30	NP-5
	34-60	Stratified silt loam to fine sandy loam.	ML	A-4	0	100	100	95-100	50-90	20-30	NP-5
44----------	0-6	Loam----------	ML, SM	A-4	0-5	90-100	85-95	60-90	35-60	25-30	NP-5
Finley	6-26	Very gravelly loam, very gravelly fine sandy loam, very gravelly very fine sandy.	GM, GP-GM	A-1	5-10	40-60	25-45	10-25	5-20	25-30	NP-5
	26-60	Very cobbly sand, very gravelly loamy sand, very gravelly sandy loam.	GP	A-1	25-35	20-30	15-25	5-10	0-5	---	NP
45*, 46*. Haploxerolls											

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
47---------- Heytou	0-10	Very stony loam	SM	A-4, A-2	25-35	70-80	50-60	40-55	25-45	20-30	NP-5
	10-19	Gravelly sandy loam, very gravelly loam, very cobbly loam.	GM	A-4, A-2	15-25	45-65	40-60	35-50	25-40	20-30	NP-5
	19-60	Very gravelly sandy loam, very cobbly loam, very gravelly loam.	GM	A-4, A-2	20-40	50-65	45-60	35-45	25-40	20-30	NP-5
48*:											
Kiona----------	0-5	Extremely stony loam.	ML	A-4	40-60	70-85	60-80	55-75	50-70	25-35	NP-5
	5-60	Very cobbly loam, very cobbly silt loam, extremely cobbly silt loam.	GM	A-2, A-1, A-4	40-60	45-70	40-60	35-50	15-45	25-35	NP-5
Rubble land.											
49, 50---------- Magallon	0-10	Fine sandy loam	SM	A-2, A-4	0-5	90-100	80-90	60-70	30-40	20-30	NP-5
	10-19	Sandy loam, fine sandy loam, very fine sandy loam.	SM	A-2, A-4	0	90-100	80-90	55-80	30-50	20-30	NP-5
	19-60	Loamy sand, loamy fine sand, fine sand.	SP-SM, SM, SP	A-1, A-2, A-3	0-5	90-100	80-90	30-60	0-15	---	NP
51---------- Malaga	0-4	Gravelly fine sandy loam.	SM, GM	A-4, A-2	0-5	60-85	50-75	45-65	25-50	20-30	NP-5
	4-12	Gravelly loam, very gravelly fine sandy loam, gravelly fine sandy loam.	SM	A-4, A-2	0-20	75-85	65-75	45-60	25-50	20-30	NP-5
	12-28	Very gravelly sandy loam, very gravelly fine sandy loam, extremely gravelly fine sandy loam.	GM	A-1, A-2	0-30	30-60	20-50	15-40	10-30	20-30	NP-5
	28-60	Very gravelly sand, extremely gravelly sand, very gravelly loamy sand.	SP, SP-SM, GP, GP-GM	A-1	5-40	30-60	20-50	15-30	0-10	---	NP
52---------- Malaga	0-4	Cobbly fine sandy loam.	ML, SM	A-4	10-30	80-95	70-85	65-80	35-55	20-30	NP-5
	4-12	Gravelly sandy loam, very gravelly fine sandy loam, gravelly loam.	SM	A-2, A-4	0-20	75-85	65-75	45-60	25-50	20-30	NP-5
	12-28	Very gravelly sandy loam, very gravelly fine sandy loam, extremely gravelly fine sandy loam.	GM	A-1, A-2	0-30	30-60	20-50	15-40	10-30	20-30	NP-5
	28-60	Very gravelly sand, extremely gravelly sand, very gravelly loamy sand.	GP, GP-GM, SP, SP-SM	A-1	5-40	30-60	20-50	15-30	0-10	---	NP

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
53*. Pits											
54, 55---------- Pogue	0-6	Fine sandy loam	SM	A-4	0	95-100	85-100	75-85	40-50	20-30	NP-5
	6-31	Gravelly fine sandy loam, extremely gravelly sandy loam, cobbly fine sandy loam.	SM, GM	A-2, A-4	0-25	60-80	55-75	40-60	25-40	20-30	NP-5
	31-60	Very gravelly sand, very cobbly sand, very gravelly loamy sand.	GP, SP	A-1	5-45	40-65	30-55	15-25	0-5	---	NP
56, 57---------- Pogue	0-6	Gravelly fine sandy loam.	SM	A-2, A-4	0-5	75-85	55-75	40-60	30-40	20-30	NP-5
	6-31	Gravelly fine sandy loam, gravelly loam, cobbly fine sandy loam.	SM, GM	A-2, A-4	0-25	60-80	55-75	40-60	25-40	20-30	NP-5
	31-60	Very gravelly sand, very cobbly sand, very gravelly loamy sand.	GP, SP	A-1	5-45	40-65	30-55	15-25	0-5	---	NP
58---------- Pogue	0-6	Cobbly fine sandy loam.	SM	A-4, A-2	10-20	75-95	65-85	60-75	30-50	20-30	NP-5
	6-31	Cobbly fine sandy loam, gravelly sandy loam, cobbly loam.	SM, GM	A-2	0-25	60-80	55-75	40-60	25-35	20-30	NP-5
	31-60	Very gravelly loamy sand, very cobbly sand, very gravelly sand.	GP, SP	A-1	5-45	40-65	30-55	15-25	0-5	---	NP
59---------- Pogue	0-6	Extremely stony fine sandy loam.	GM	A-4, A-2	40-50	60-75	60-70	50-60	30-50	20-30	NP-5
	6-31	Cobbly fine sandy loam, gravelly sandy loam, cobbly loam.	SM, GM	A-2	0-25	60-80	55-75	40-60	25-35	20-30	NP-5
	31-60	Very gravelly loamy sand, very cobbly sand, very gravelly sand.	GP, SP	A-1	5-45	40-65	30-55	15-25	0-5	---	NP
60---------- Pogue	0-6	Bouldery fine sandy loam.	SM	A-4, A-2	10-20	75-95	65-85	60-75	30-50	20-30	NP-5
	6-31	Cobbly fine sandy loam, gravelly sandy loam, cobbly loam.	SM, GM	A-2	0-25	60-80	55-75	40-60	25-35	20-30	NP-5
	31-60	Very gravelly loamy sand, very cobbly sand, very gravelly sand.	GP, SP	A-1	5-45	40-65	30-55	15-25	0-5	---	NP

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
61---------- Pogue	0-10	Loam----------	ML	A-4	0-5	90-100	85-100	75-85	50-70	20-30	NP-5
	10-25	Gravelly fine sandy loam, gravelly loam, loam.	SM, GM	A-2, A-4	0-25	60-80	55-75	40-60	25-40	20-30	NP-5
	25-60	Very gravelly sand, very cobbly sand, very gravelly loamy sand.	GP, SP	A-1	5-45	40-65	30-55	15-25	0-5	---	NP
62---------- Quincy	0-10	Fine sand--------	SM	A-2	0	100	100	90-100	15-30	---	NP
	10-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	100	65-80	15-30	---	NP
63---------- Quincy	0-10	Loamy fine sand	SM	A-2	0	100	100	90-100	15-30	---	NP
	10-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	100	65-80	15-30	---	NP
64*:											
Ralls----------	0-10	Very cobbly silt loam.	ML, SM, CL-ML, SM-SC	A-4	25-35	70-85	60-75	55-70	40-60	20-30	NP-10
	10-20	Gravelly clay loam, gravelly silt loam, cobbly silt loam.	CL	A-6	5-10	70-85	60-75	60-70	50-60	20-40	10-20
	20-32	Gravelly silt loam, gravelly clay loam.	SM-SC, SC	A-4, A-6	5-15	70-80	60-70	45-60	35-50	20-35	5-15
	32-60	Very gravelly silt loam, gravelly clay loam.	GM-GC, GC	A-2	10-20	40-60	40-60	25-40	20-35	20-35	5-15
Renslow----------	0-10	Silt loam--------	ML	A-4	0	100	95-100	95-100	80-95	20-30	NP-5
	10-31	Silt loam--------	CL-ML	A-4	0	100	95-100	95-100	80-95	20-30	5-10
	31-60	Silt loam, silt	ML, CL-ML	A-4	0	100	95-100	90-100	80-90	20-30	NP-10
Bakeoven--------	0-4	Very cobbly loam	GM	A-2, A-4	35-60	50-70	40-65	35-55	30-50	25-35	NP-10
	4-9	Very gravelly clay loam, very cobbly loam, very gravelly loam.	GM	A-4	20-55	50-65	45-60	40-55	35-50	30-40	5-10
	9	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
65*:											
Renslow---------- (0 to 15 percent slopes)	0-10	Silt loam--------	ML	A-4	0	100	95-100	95-100	80-95	20-30	NP-5
	10-31	Silt loam--------	CL-ML	A-4	0	100	95-100	95-100	80-95	20-30	5-10
	31-60	Silt loam, silt	ML, CL-ML	A-4	0	100	95-100	90-100	80-90	20-30	NP-10
Dougville--------	0-9	Loam----------	ML	A-4	0	100	95-100	80-95	60-70	30-40	NP-5
	9-42	Loam, silt loam	ML	A-4	0	100	95-100	80-95	60-75	30-40	NP-5
	42-60	Silt loam--------	ML	A-4	0	100	100	90-100	80-95	25-35	NP-10
Renslow---------- (15 to 30 percent slopes)	0-10	Silt loam--------	ML	A-4	0	100	95-100	95-100	80-95	20-30	NP-5
	10-31	Silt loam--------	CL-ML	A-4	0	100	95-100	95-100	80-95	20-30	5-10
	31-60	Silt loam, silt	ML, CL-ML	A-4	0	100	95-100	90-100	80-90	20-30	NP-10

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
66*:											
Renslow	0-10	Silt loam	ML	A-4	0	100	95-100	95-100	80-95	20-30	NP-5
	10-31	Silt loam	CL-ML	A-4	0	100	95-100	95-100	80-95	20-30	5-10
	31-60	Silt loam, silt	ML, CL-ML	A-4	0	100	95-100	90-100	80-90	20-30	NP-10
Zen	0-18	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	80-90	20-40	5-15
	18-34	Silt loam	CL	A-6	0	100	95-100	90-100	80-90	30-40	10-15
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
67 Rock Creek	0-3	Very cobbly silt loam.	ML, GM	A-4	30-45	60-75	50-65	45-60	40-55	20-30	NP-5
	3-12	Very gravelly clay loam, very cobbly clay, extremely cobbly clay.	GM	A-2, A-7	15-70	35-70	20-50	20-45	20-40	40-50	10-20
	12	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
68*:											
Rubble land.											
Rock outcrop.											
69 Umapine Variant	0-10	Loam	ML	A-4	0	100	100	95-100	75-85	20-30	NP-5
	10-29	Silt loam, loam	ML	A-4	0	100	100	95-100	75-85	20-30	NP-5
	29-36	Cemented	---	---	---	---	---	---	---	---	---
	36-60	Silt loam, loam	ML	A-4	0	100	100	95-100	70-85	20-30	NP-5
70 Strat	0-10	Very cobbly silt loam.	GM, SM	A-4	30-40	60-75	55-70	50-60	40-50	30-40	5-10
	10-22	Very cobbly loam, very gravelly loam.	GM, SM	A-2, A-4	15-55	60-75	35-50	30-45	25-40	30-40	5-10
	22-60	Extremely gravelly coarse sand, extremely gravelly sand.	GP	A-1	25-35	40-50	10-45	5-10	0-5	---	NP
71, 72 Supplee	0-6	Very fine sandy loam.	SM	A-4	0-5	85-100	75-100	60-85	35-50	30-40	NP-5
	6-30	Very fine sandy loam, gravelly very fine sandy loam.	SM	A-4	0-5	85-100	75-100	60-85	35-50	30-40	NP-5
	30-60	Extremely cobbly sand, extremely gravelly sand.	GP	A-1	25-65	25-35	10-20	5-10	0-5	---	NP
73 Timentwa	0-10	Loam	SM, ML	A-4	0-5	85-100	75-95	60-85	40-65	20-30	NP-5
	10-18	Gravelly fine sandy loam, gravelly loam, very fine sandy loam.	SM	A-2, A-4	0-5	70-85	60-85	45-75	25-50	25-35	NP-10
	18-41	Gravelly fine sandy loam, gravelly loam.	SM, GM	A-2, A-4	5-10	60-80	50-65	40-60	25-50	25-35	NP-10
	41-52	Cemented	---	---	---	---	---	---	---	---	---
	52-60	Very gravelly fine sandy loam, very gravelly loam, very cobbly sandy loam.	SM, GM	A-2, A-4, A-1	10-25	60-75	45-65	35-50	20-40	25-35	NP-10

See footnote at end of table.

TABLE 17.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
74----------	0-10	Loam----------	ML	A-4	0-5	95-100	95-100	70-85	60-70	20-30	NP-5
Touhey	10-28	Gravelly loam, gravelly fine sandy loam, loam.	ML	A-4	5-10	85-95	70-80	65-75	50-60	20-30	NP-5
	28-60	Gravelly loam, cobbly loam.	SM	A-4	5-20	70-80	55-75	55-65	40-50	20-30	NP-5
75----------	0-20	Silt loam--------	ML	A-4	0	100	100	90-100	75-90	20-30	NP-5
Willis	20-28	Silt loam--------	ML	A-4	0	95-100	90-100	90-100	80-90	20-30	NP-5
	28	Indurated--------	---	---	---	---	---	---	---	---	---
76*. Xerofluvents											
77*. Xerorthents											
78*:											
Zen----------	0-18	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	80-90	20-40	5-15
	18-34	Silt loam--------	CL	A-6	0	100	95-100	90-100	80-90	30-40	10-15
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bakeoven--------	0-4	Very cobbly loam	GM	A-2, A-4	35-60	50-70	40-65	35-55	30-50	25-35	NP-10
	4-9	Very gravelly clay loam, very gravelly silt loam, very gravelly loam.	GM	A-4	20-55	50-65	45-60	40-55	35-50	30-40	5-10
	9	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Lickskillet-----	0-4	Cobbly silt loam	CL-ML, ML	A-4	10-30	70-95	60-80	55-75	50-65	25-35	5-10
	4-18	Very gravelly silt loam, very gravelly loam, gravelly loam.	GC	A-2, A-6, A-7	15-50	40-65	25-50	20-50	15-40	35-45	15-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
10*. Aquolls											
11---------- Badge	0-13	10-20	1.25-1.45	0.6-2.0	0.10-0.12	6.6-7.8	Low----------	0.28	5	8	1-3
	13-28	24-35	1.30-1.50	0.2-0.6	0.09-0.12	6.6-7.8	Low----------	0.32			
	28-60	15-25	1.40-1.50	0.6-2.0	0.08-0.11	7.4-8.4	Low----------	0.28			
12*:											
Bakeoven--------	0-4	15-25	1.25-1.35	0.6-2.0	0.06-0.09	6.1-7.8	Low----------	0.15	1	8	1-3
	4-9	18-33	1.30-1.40	0.2-0.6	0.05-0.14	6.6-7.8	Low----------	0.20			
	9	---	---	---	---	---	----------	----			
Lickskillet-----	0-4	15-25	1.25-1.35	0.6-2.0	0.08-0.11	7.4-7.8	Low----------	0.17	1	8	1-2
	4-18	23-33	1.30-1.40	0.6-2.0	0.06-0.14	6.6-8.4	Low----------	0.24			
	18	---	---	---	---	---	----------	----			
13*:											
Bakeoven--------	0-4	15-25	1.25-1.35	0.2-0.6	0.06-0.09	6.1-7.8	Low----------	0.15	1	---	1-3
	4-9	18-33	1.30-1.40	0.2-0.6	0.05-0.14	6.6-7.8	Low----------	0.20			
	9	---	---	---	---	---	----------	----			
Touhey----------	0-10	10-15	1.25-1.45	0.6-2.0	0.16-0.18	7.4-7.8	Low----------	0.37	2	5	1-2
	10-28	10-15	1.30-1.50	0.6-2.0	0.16-0.18	7.4-7.8	Low----------	0.32			
	28-60	10-15	1.30-1.50	0.2-0.6	---	7.9-9.0	Low----------	0.28			
14---------- Beverly	0-5	5-10	1.40-1.50	0.6-2.0	0.14-0.18	6.6-7.8	Low----------	0.28	2	3	.5-1
	5-20	4-10	1.40-1.50	2.0-6.0	0.07-0.12	6.6-7.8	Low----------	0.15			
	20-60	0-5	1.50-1.60	>20	0.04-0.06	6.6-7.8	Low----------	0.10			
15---------- Beverly	0-5	5-10	1.40-1.50	2.0-6.0	0.12-0.14	6.6-7.8	Low----------	0.15	2	3	.5-1
	5-20	4-8	1.40-1.50	2.0-6.0	0.07-0.12	6.6-7.8	Low----------	0.15			
	20-60	0-5	1.50-1.60	>20	0.04-0.07	6.6-7.8	Low----------	0.10			
16*:											
Broadax---------	0-13	10-18	1.25-1.45	0.6-2.0	0.17-0.21	6.1-7.8	Low----------	0.43	5	5	2-3
	13-35	20-35	1.50-1.60	0.6-2.0	0.17-0.20	7.4-8.4	Moderate------	0.32			
	35-60	15-25	1.35-1.60	0.6-2.0	0.17-0.19	7.9-9.0	Low----------	0.43			
Condon----------	0-7	15-20	1.25-1.35	0.6-2.0	0.20-0.25	6.1-7.3	Low----------	0.32	2	5	2-3
	7-34	18-24	1.30-1.40	0.6-2.0	0.19-0.21	6.1-7.3	Low----------	0.43			
	34	---	---	---	---	---	----------	----			
17, 18---------- Burbank	0-6	0-5	1.50-1.60	6.0-20	0.11-0.15	7.4-7.8	Low----------	0.24	2	2	.5-1
	6-20	0-5	1.50-1.60	6.0-20	0.10-0.14	7.4-8.4	Low----------	0.24			
	20-60	0-2	1.50-1.60	>20	0.01-0.03	7.4-8.4	Low----------	0.10			
19---------- Burch	0-10	5-12	1.25-1.35	0.6-2.0	0.14-0.18	6.6-7.3	Low----------	0.28	5	3	1-2
	10-60	10-15	1.25-1.35	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.32			
20, 21---------- Burch	0-10	10-15	1.25-1.35	0.6-2.0	0.17-0.20	6.6-7.3	Low----------	0.37	5	5	1-2
	10-60	10-15	1.25-1.35	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.32			
22, 23, 24------- Cashmere	0-11	8-12	1.35-1.50	2.0-6.0	0.13-0.15	6.1-7.8	Low----------	0.32	5	3	1-2
	11-60	8-12	1.35-1.50	2.0-6.0	0.12-0.14	6.6-7.8	Low----------	0.37			
25---------- Cashmont	0-21	6-12	1.35-1.50	2.0-6.0	0.11-0.13	6.6-7.8	Low----------	0.24	5	3	1-2
	21-28	6-12	1.35-1.50	2.0-6.0	0.10-0.12	6.6-7.8	Low----------	0.24			
	28-60	6-12	1.35-1.50	2.0-6.0	0.09-0.11	6.6-7.8	Low----------	0.24			

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
26, 27----------	0-21	6-12	1.35-1.50	2.0-6.0	0.09-0.11	6.6-7.8	Low----------	0.20	5	4	1-2
Cashmont	21-28	6-12	1.35-1.50	2.0-6.0	0.10-0.12	6.6-7.8	Low----------	0.24			
	28-60	6-12	1.35-1.50	2.0-6.0	0.09-0.11	6.6-7.8	Low----------	0.24			
28----------	0-21	6-12	1.35-1.50	2.0-6.0	0.08-0.10	6.6-7.8	Low----------	0.24	5	4	1-2
Cashmont	21-28	6-12	1.35-1.50	2.0-6.0	0.10-0.12	6.6-7.8	Low----------	0.24			
	28-60	6-12	1.35-1.50	2.0-6.0	0.09-0.11	6.6-7.8	Low----------	0.24			
29, 30----------	0-12	5-10	1.40-1.50	0.6-2.0	0.13-0.15	6.6-8.4	Low----------	0.28	5	3	1-2
Cashmont Variant	12-20	5-15	1.40-1.50	0.6-2.0	0.14-0.18	6.6-8.4	Low----------	0.32			
	20-60	5-15	1.40-1.50	0.2-0.6	0.07-0.10	7.9-8.4	Low----------	0.24			
31----------	0-9	---	0.85-0.95	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.37	3	3	.5-1
Chelan	9-22	---	0.85-0.95	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.37			
	22-50	---	0.85-0.95	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.43			
	50-60	---	1.30-1.50	>20	0.04-0.07	6.6-8.4	Low----------	0.10			
32*:											
Chelan----------	0-10	---	.85-.95	0.6-2.0	0.12-0.14	6.6-7.8	Low----------	0.37	5	4	.5-1
(3 to 30	10-25	---	.85-.95	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.37			
percent	25-46	---	.85-.95	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.43			
slopes)	46-60	8-14	1.30-1.40	0.2-0.6	0.11-0.13	7.4-9.0	Low----------	0.28			
Chelan----------	0-10	---	.85-.95	0.6-2.0	0.12-0.14	6.6-7.8	Low----------	0.37	5	4	.5-1
(30 to 65	10-25	---	.85-.95	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.37			
percent	25-46	---	.85-.95	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.43			
slopes)	46-60	8-14	1.30-1.40	0.2-0.6	0.11-0.13	7.4-9.0	Low----------	0.28			
33*:											
Chelan----------	0-10	---	0.85-0.95	0.6-2.0	0.18-0.20	6.6-7.8	Low----------	0.37	3	5	.5-1
(30 to 65	10-25	---	0.85-0.95	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.37			
percent	25-46	---	0.85-0.95	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.43			
slopes)	46-60	8-14	1.30-1.40	0.2-0.6	0.11-0.13	7.4-9.0	Low----------	0.28			
Chelan----------	0-10	---	0.85-0.95	0.6-2.0	0.18-0.20	6.6-7.8	Low----------	0.37	3	5	.5-1
(3 to 30	10-25	---	0.85-0.95	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.37			
percent	25-46	---	0.85-0.95	0.6-2.0	0.17-0.20	6.6-7.8	Low----------	0.43			
slopes)	46-60	8-14	1.30-1.40	0.2-0.6	0.11-0.13	7.4-9.0	Low----------	0.28			
34*:											
Condon----------	0-7	15-20	1.25-1.35	0.6-2.0	0.20-0.25	6.1-7.3	Low----------	0.32	2	5	2-3
	7-34	18-24	1.30-1.40	0.6-2.0	0.19-0.21	6.1-7.8	Low----------	0.43			
	34	---	---	---	---	---	----------	----			
Rock Creek------	0-3	20-27	1.25-1.35	0.6-2.0	0.10-0.12	6.1-7.3	Low----------	0.37	1	8	1-2
	3-12	35-45	1.30-1.40	0.2-0.6	0.04-0.06	6.1-7.3	Moderate-----	0.17			
	12	---	---	---	---	---	----------	----			
Broadax---------	0-13	10-18	1.25-1.45	0.6-2.0	0.17-0.21	6.1-7.8	Low----------	0.43	5	5	2-3
	13-35	20-35	1.50-1.60	0.6-2.0	0.17-0.20	7.4-8.4	Moderate-----	0.32			
	35-60	15-25	1.35-1.60	0.6-2.0	0.17-0.19	7.9-9.0	Low----------	0.43			
35*:											
Cordy----------	0-12	18-25	1.25-1.45	0.6-2.0	0.17-0.20	6.1-7.3	Low----------	0.37	5	5	1-2
(3 to 30	12-40	20-25	1.30-1.50	0.6-2.0	0.17-0.20	6.1-7.3	Low----------	0.32			
percent	40-60	20-25	1.25-1.45	0.6-2.0	0.17-0.20	6.1-7.3	Low----------	0.28			
slopes)											
Cordy----------	0-12	18-25	1.25-1.45	0.6-2.0	0.17-0.20	6.1-7.3	Low----------	0.37	5	5	1-2
(30 to 55	12-40	20-25	1.30-1.50	0.6-2.0	0.17-0.20	6.1-7.3	Low----------	0.32			
percent	40-60	20-25	1.25-1.45	0.6-2.0	0.17-0.20	6.1-7.3	Low----------	0.28			
36*:											
Cordy----------	0-12	18-25	1.25-1.45	0.6-2.0	0.17-0.20	6.1-7.3	Low----------	0.37	5	5	1-2
	12-40	20-25	1.30-1.50	0.6-2.0	0.17-0.20	6.1-7.3	Low----------	0.32			
	40-60	20-25	1.25-1.45	0.6-2.0	0.17-0.20	6.1-7.3	Low----------	0.28			

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
36*:											
Rock Creek------	0-3	20-27	1.25-1.35	0.6-2.0	0.10-0.12	6.1-7.3	Low----------	0.37	1	8	1-2
	3-12	35-45	1.25-1.35	0.2-0.6	0.04-0.06	6.1-7.3	Moderate-----	0.17			
	12	---	---	---	---	---	----------	----			
37----------	0-13	7-15	1.25-1.35	0.6-2.0	0.13-0.16	6.6-7.8	Low----------	0.32	4	5	1-5
Dinkels	13-24	5-15	1.30-1.50	0.6-2.0	0.10-0.13	6.6-7.8	Low----------	0.28			
	24-43	2-7	1.30-1.50	0.6-2.0	0.05-0.07	6.6-7.8	Low----------	0.17			
	43	---	---	---	---	---	----------	----			
38----------	0-9	8-12	1.25-1.40	0.6-2.0	0.17-0.22	6.6-7.8	Low----------	0.37	5	5	1-2
Dougville	9-42	8-12	1.25-1.40	0.6-2.0	0.17-0.21	6.6-7.8	Low----------	0.37			
	42-60	12-16	1.25-1.40	0.6-2.0	0.17-0.20	7.9-8.4	Low----------	0.37			
39----------	0-12	8-12	---	0.6-2.0	0.13-0.15	6.6-7.8	Low----------	0.37	5	3	1-2
Ellisforde	12-27	10-18	---	0.6-2.0	0.15-0.23	7.4-8.4	Low----------	0.49			
	27-60	10-18	---	0.2-0.6	0.20-0.23	8.5-9.0	Low----------	0.43			
40----------	0-12	10-18	---	0.6-2.0	0.15-0.23	6.6-7.8	Low----------	0.49	5	5	1-2
Ellisforde	12-27	10-18	---	0.6-2.0	0.15-0.23	7.4-8.4	Low----------	0.49			
	27-60	10-18	---	0.2-0.6	0.20-0.23	8.5-9.0	Low----------	0.43			
41*:											
Ellisforde------	0-12	10-18	---	0.6-2.0	0.15-0.23	6.6-7.8	Low----------	0.49	5	5	1-2
(15 to 30	12-27	10-18	---	0.6-2.0	0.15-0.23	7.4-8.4	Low----------	0.49			
percent	27-60	10-18	---	0.2-0.6	0.20-0.23	8.5-9.0	Low----------	0.43			
slopes)											
Ellisforde------	0-12	10-18	---	0.6-2.0	0.15-0.23	6.6-7.8	Low----------	0.49	5	5	1-2
(30 to 60	12-27	10-18	---	0.6-2.0	0.15-0.23	7.4-8.4	Low----------	0.49			
percent	27-60	10-18	---	0.2-0.6	0.20-0.23	8.5-9.0	Low----------	0.43			
slopes)											
42*:											
Entiat----------	0-6	6-10	---	2.0-6.0	0.10-0.12	6.6-7.8	Low----------	0.28	1	4	1-2
	6-11	8-14	---	2.0-6.0	0.12-0.14	6.6-7.8	Low----------	0.17			
	11-17	8-14	---	2.0-6.0	0.07-0.08	6.6-7.8	Low----------	0.15			
	17	---	---	---	---	---	----------	----			
Rock outcrop.											
43----------	0-10	2-6	1.00-1.15	0.6-2.0	0.19-0.25	6.6-7.8	Low----------	0.43	5	5	1-2
Esquatzel	10-34	5-15	1.15-1.35	0.6-2.0	0.19-0.23	7.4-8.4	Low----------	0.43			
	34-60	5-15	1.15-1.35	0.6-2.0	0.18-0.23	7.4-8.4	Low----------	0.43			
44----------	0-6	4-10	---	2.0-6.0	0.13-0.15	7.4-8.4	Low----------	0.37	2	5	.5-1
Finley	6-26	4-10	---	2.0-6.0	0.08-0.11	7.4-8.4	Low----------	0.28			
	26-60	0-4	---	>20	0.03-0.05	7.4-8.4	Low----------	0.10			
45*, 46*. Haploxerolls											
47----------	0-10	10-15	---	0.6-2.0	0.13-0.15	7.4-7.8	Low----------	0.32	2	5	1-2
Heytou	10-19	10-18	---	0.6-2.0	0.08-0.13	7.4-7.8	Low----------	0.32			
	19-60	10-18	---	0.6-2.0	0.05-0.08	7.9-9.0	Low----------	0.28			
48*:											
Kiona----------	0-5	7-15	---	0.6-2.0	0.15-0.18	7.4-7.8	Low----------	0.37	5	5	.5-1
	5-60	5-15	---	0.6-2.0	0.05-0.07	7.4-8.4	Low----------	0.28			
Rubble land.											
49, 50----------	0-10	8-13	---	2.0-6.0	0.12-0.14	7.4-8.4	Low----------	0.24	3	3	1-3
Magallon	10-19	8-13	---	2.0-6.0	0.12-0.14	7.4-9.0	Low----------	0.28			
	19-60	0-5	---	6.0-20	0.04-0.07	7.4-9.0	Low----------	0.10			

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
51----------	0-4	5-15	1.30-1.40	0.6-2.0	0.11-0.13	6.1-7.8	Low----------	0.32	1	4	.7-1
Malaga	4-12	5-15	1.30-1.40	0.6-2.0	0.10-0.14	6.1-7.8	Low----------	0.28			
	12-28	5-15	1.30-1.40	2.0-6.0	0.07-0.08	6.1-7.8	Low----------	0.17			
	28-60	0-5	1.30-1.40	>20	0.04-0.07	6.1-7.8	Low----------	0.10			
52----------	0-4	5-15	---	0.6-2.0	0.11-0.13	6.1-7.8	Low----------	0.32	1	4	.7-1
Malaga	4-12	5-15	---	0.6-2.0	0.10-0.14	6.1-7.8	Low----------	0.28			
	12-28	5-15	---	2.0-6.0	0.07-0.08	6.1-7.8	Low----------	0.17			
	28-60	0-5	---	>20	0.04-0.07	6.1-7.8	Low----------	0.10			
53*.											
Pits											
54, 55----------	0-6	5-10	1.30-1.40	2.0-6.0	0.13-0.15	6.1-7.8	Low----------	0.32	2	3	1-2
Pogue	6-31	5-10	1.30-1.40	2.0-6.0	0.10-0.12	6.1-7.8	Low----------	0.28			
	31-60	0-5	1.35-1.45	>20	0.02-0.04	6.1-7.8	Low----------	0.10			
56, 57----------	0-6	5-10	1.30-1.40	2.0-6.0	0.10-0.12	6.1-7.8	Low----------	0.28	2	4	1-2
Pogue	6-31	5-10	1.30-1.40	2.0-6.0	0.10-0.12	6.1-7.8	Low----------	0.28			
	31-60	0-5	1.35-1.45	>20	0.02-0.04	6.1-7.8	Low----------	0.10			
58----------	0-6	5-10	1.30-1.40	2.0-6.0	0.13-0.15	6.1-7.8	Low----------	0.32	2	4	1-2
Pogue	6-31	5-10	1.30-1.40	2.0-6.0	0.12-0.14	6.1-7.8	Low----------	0.28			
	31-60	0-10	1.35-1.45	>20	0.02-0.04	6.1-7.8	Low----------	0.10			
59----------	0-6	5-10	1.30-1.40	2.0-6.0	0.12-0.14	6.1-7.8	Low----------	0.32	2	4	1-2
Pogue	6-31	5-10	1.30-1.40	2.0-6.0	0.12-0.14	6.1-7.8	Low----------	0.28			
	31-60	0-10	1.35-1.45	>20	0.02-0.04	6.1-7.8	Low----------	0.10			
60----------	0-6	5-10	1.30-1.40	2.0-6.0	0.13-0.15	6.1-7.8	Low----------	0.32	2	4	1-2
Pogue	6-31	5-10	1.30-1.40	2.0-6.0	0.12-0.14	6.1-7.8	Low----------	0.28			
	31-60	0-10	1.35-1.45	>20	0.02-0.04	6.1-7.8	Low----------	0.10			
61----------	0-10	5-10	1.30-1.40	2.0-6.0	0.14-0.16	6.1-7.8	Low----------	0.32	2	5	1-2
Pogue	10-25	5-10	1.30-1.40	2.0-6.0	0.10-0.12	6.1-7.8	Low----------	0.28			
	25-60	0-5	1.35-1.45	>20	0.02-0.04	6.1-7.8	Low----------	0.10			
62----------	0-10	1-6	---	6.0-20	0.06-0.09	6.1-7.8	Low----------	0.17	5	1	<.8
Quincy	10-60	1-7	---	6.0-20	0.06-0.09	6.6-8.4	Low----------	0.17			
63----------	8-10	1-6	---	6.0-20	0.06-0.09	6.1-7.8	Low----------	0.17	5	2	<.8
Quincy	10-60	1-7	---	6.0-20	0.06-0.09	6.6-8.4	Low----------	0.17			
64*:											
Ralls----------	0-10	6-10	1.30-1.40	0.6-2.0	0.13-0.15	7.4-8.4	Low----------	0.32	3	8	1-2
	10-20	18-30	1.30-1.40	0.2-0.6	0.12-0.14	7.4-8.4	Moderate-----	0.28			
	20-32	16-30	1.30-1.40	0.2-0.6	0.12-0.14	7.4-8.4	Moderate-----	0.32			
	32-60	16-30	1.30-1.40	0.6-2.0	0.12-0.14	7.4-9.0	Moderate-----	0.28			
Renslow----------	0-10	5-10	1.20-1.30	0.6-2.0	0.19-0.21	6.6-7.8	Low----------	0.49	5	5	1-2
	10-31	10-18	1.20-1.55	0.6-2.0	0.19-0.21	7.4-8.4	Low----------	0.55			
	31-60	7-15	1.15-1.35	0.6-2.0	0.19-0.21	7.9-9.0	Low----------	0.55			
Bakeoven---------	0-4	15-25	1.25-1.35	0.2-0.6	0.06-0.09	6.1-7.8	Low----------	0.15	1	8	1-3
	4-9	18-33	1.30-1.40	0.2-0.6	0.05-0.14	6.6-7.8	Low----------	0.20			
	9	---	---	---	---	---	----------	----			
65*:											
Renslow----------	0-10	5-10	1.20-1.30	0.6-2.0	0.19-0.21	6.6-7.8	Low----------	0.49	5	5	1-2
(0 to 15 percent slopes)	10-31	10-18	1.20-1.55	0.6-2.0	0.19-0.21	7.4-8.4	Low----------	0.55			
	31-60	7-15	1.15-1.35	0.6-2.0	0.19-0.21	7.9-9.0	Low----------	0.55			
Dougville--------	0-9	8-12	---	0.6-2.0	0.17-0.22	6.6-7.8	Low----------	0.37	5	5	1-2
	9-42	8-12	---	0.6-2.0	0.17-0.21	6.6-7.8	Low----------	0.37			
	42-60	12-16	---	0.6-2.0	0.17-0.20	7.9-8.4	Low----------	0.37			

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
65*:											
Renslow	0-10	5-10	1.20-1.30	0.6-2.0	0.19-0.21	6.6-7.8	Low	0.49	5	5	1-2
(15 to 30 percent slopes)	10-31	10-18	1.20-1.55	0.6-2.0	0.19-0.21	7.4-8.4	Low	0.55			
	31-60	7-15	1.15-1.35	0.6-2.0	0.19-0.21	7.9-9.0	Low	0.55			
66*:											
Renslow	0-10	5-10	1.20-1.30	0.6-2.0	0.19-0.21	6.6-7.8	Low	0.49	5	5	1-2
	10-31	10-18	1.20-1.55	0.6-2.0	0.19-0.21	7.4-8.4	Low	0.55			
	31-60	7-15	1.15-1.35	0.6-2.0	0.19-0.21	7.9-9.0	Low	0.55			
Zen	0-18	18-25	1.30-1.40	0.6-2.0	0.17-0.20	6.1-7.8	Moderate	0.43	2	5	1-2
	18-34	18-25	1.30-1.40	0.6-2.0	0.16-0.19	6.6-8.4	Moderate	0.37			
	34	---	---	---	---	---	---	---			
67	0-3	20-27	---	0.6-2.0	0.10-0.12	6.1-7.3	Low	0.37	1	8	1-2
Rock Creek	3-12	35-45	---	0.2-0.6	0.04-0.06	6.1-7.3	Moderate	0.17			
	12	---	---	---	---	---	---	---			
68*:											
Rubble land.											
Rock outcrop.											
69	0-10	10-18	---	0.6-2.0	0.16-0.18	7.9-8.4	Low	0.37	2	4L	1-2
Umapine Variant	10-29	10-18	---	0.6-2.0	0.18-0.21	>8.4	Low	0.43			
	29-36	---	---	---	---	---	---	---			
	36-60	10-18	---	0.6-2.0	0.18-0.21	>9.0	Low	0.43			
70	0-10	7-12	1.20-1.30	0.6-2.0	0.08-0.12	7.4-8.4	Low	0.32	2	5	1-2
Strat	10-22	7-12	1.20-1.30	0.6-2.0	0.08-0.12	7.4-8.4	Low	0.28			
	22-60	1-3	1.00-1.10	>20	0.04-0.07	7.4-8.4	Low	0.10			
71, 72	0-6	---	.85-.95	0.6-2.0	0.17-0.22	6.6-7.8	Low	0.37	2	3	.5-1
Supplee	6-30	---	.85-.95	0.6-2.0	0.17-0.20	6.6-7.8	Low	0.37			
	30-60	0-2	1.30-1.50	>20.0	0.04-0.07	6.6-8.4	Low	0.10			
73	0-10	10-15	---	0.6-2.0	0.14-0.16	6.6-7.8	Low	0.32	3	5	1-3
Timentwa	10-18	10-18	---	0.6-2.0	0.16-0.18	7.4-8.4	Low	0.28			
	18-41	10-18	---	0.6-2.0	0.12-0.14	7.9-9.0	Low	0.10			
	41-52	---	---	---	---	---	---	---			
	52-60	10-18	---	0.2-0.6	0.12-0.14	7.9-9.0	Low	0.28			
74	0-10	10-15	---	0.6-2.0	0.16-0.18	7.4-7.8	Low	0.37	2	5	1-2
Touhey	10-28	10-15	---	0.6-2.0	0.16-0.18	7.4-8.4	Low	0.32			
	28-60	10-15	---	0.2-0.6	---	7.9-9.0	Low	0.28			
75	0-20	10-15	1.35-1.50	0.6-2.0	0.19-0.21	6.6-7.8	Low	0.49	2	5	1-2
Willis	20-28	10-15	1.35-1.50	0.6-2.0	0.18-0.20	7.9-9.0	Low	0.55			
	28	---	---	---	---	---	---	---			
76*.											
Xerofluvents											
77*.											
Xerorthents											
78*:											
Zen	0-18	18-25	1.30-1.40	0.6-2.0	0.17-0.20	6.1-7.8	Moderate	0.43	2	5	1-2
	18-34	18-25	1.30-1.40	0.6-2.0	0.16-0.19	6.6-8.4	Moderate	0.37			
	34	---	---	---	---	---	---	---			
Bakeoven	0-4	15-25	1.25-1.35	0.2-0.6	0.06-0.09	6.1-7.8	Low	0.15	1	8	1-3
	4-9	18-33	1.30-1.40	0.2-0.6	0.05-0.14	6.6-7.8	Low	0.20			
	9	---	---	---	---	---	---	---			

See footnote at end of table.

TABLE 18.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm³	In/hr	In/in	pH					Pct
78*:											
Lickskillet-----	0-4	15-25	1.25-1.35	0.6-2.0	0.08-0.11	7.4-7.8	Low----------	0.17	1	8	1-2
	4-18	23-33	1.30-1.40	0.6-2.0	0.06-0.14	6.6-7.3	Low----------	0.24			
	18	---	---	---	---	---	----------	----			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--WATER FEATURES

[See text for definition of terms. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern.

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
10*. Aquolls							
11---------- Badge	B	None----------	---	---	>6.0	---	---
12*:							
Bakeoven----------	D	None----------	---	---	>6.0	---	---
Lickskillet----------	D	None----------	---	---	>6.0	---	---
13*:							
Bakeoven----------	D	None----------	---	---	>6.0	---	---
Touhey----------	B	None----------	---	---	>6.0	---	---
14, 15---------- Beverly	B	Rare----------	---	---	>6.0	---	---
16*:							
Broadax----------	C	None----------	---	---	>6.0	---	---
Condon----------	C	None----------	---	---	>6.0	---	---
17, 18---------- Burbank	A	None----------	---	---	>6.0	---	---
19, 20, 21---------- Burch	B	None----------	---	---	>6.0	---	---
22, 23, 24---------- Cashmere	B	None----------	---	---	>6.0	---	---
25, 26, 27, 28---------- Cashmont	B	None----------	---	---	>6.0	---	---
29, 30---------- Cashmont Variant	B	None----------	---	---	>6.0	---	---
31---------- Chelan	B	None----------	---	---	>6.0	---	---
32*:							
Chelan---------- (3 to 30 percent slopes)	B	None----------	---	---	>6.0	---	---
Chelan---------- (30 to 65 percent slopes)	B	None----------	---	---	>6.0	---	---
33*:							
Chelan---------- (30 to 65 percent slopes)	B	None----------	---	---	>6.0	---	---
Chelan---------- (3 to 30 percent slopes)	B	None----------	---	---	>6.0	---	---

See footnote at end of table.

TABLE 19.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
34*:							
Condon	C	None	---	---	>6.0	---	---
Rock Creek	D	None	---	---	>6.0	---	---
Broadax	C	None	---	---	>6.0	---	---
35*:							
Cordy (3 to 30 percent slopes)	B	None	---	---	>6.0	---	---
Cordy (30 to 55 percent slopes)	B	None	---	---	>6.0	---	---
36*:							
Cordy	B	None	---	---	>6.0	---	---
Rock Creek	D	None	---	---	>6.0	---	---
37--- Dinkels	B	None	---	---	>6.0	---	---
38--- Dougville	B	None	---	---	>6.0	---	---
39, 40--- Ellisforde	C	None	---	---	>6.0	---	---
41*:							
Ellisforde (15 to 30 percent slopes)	C	None	---	---	>6.0	---	---
Ellisforde (30 to 60 percent slopes)	C	None	---	---	>6.0	---	---
42*:							
Entiat	D	None	---	---	>6.0	---	---
Rock outcrop.							
43--- Esquatzel	B	Rare	---	---	>6.0	---	---
44--- Finley	B	None	---	---	>6.0	---	---
45*, 46*. Haploxerolls							
47--- Heytou	B	None	---	---	>6.0	---	---
48*:							
Kiona	B	None	---	---	>6.0	---	---
Rubble land.							
49, 50--- Magallon	B	None	---	---	>6.0	---	---
51, 52--- Malaga	B	None	---	---	>6.0	---	---

See footnote at end of table.

TABLE 19.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
53*. Pits							
54, 55, 56, 57, 58, 59, 60, 61---- Pogue	B	None----	---	---	>6.0	---	---
62, 63---- Quincy	A	None----	---	---	>6.0	---	---
64*:							
Ralls----	B	None----	---	---	>6.0	---	---
Renslow----	B	None----	---	---	>6.0	---	---
Bakeoven----	D	None----	---	---	>6.0	---	---
65*:							
Renslow---- (0 to 15 percent slopes)	B	None----	---	---	>6.0	---	---
Dougville----	B	None----	---	---	>6.0	---	---
Renslow---- (15 to 30 percent slopes)	B	None----	---	---	>6.0	---	---
66*:							
Renslow----	B	None----	---	---	>6.0	---	---
Zen----	C	None----	---	---	>6.0	---	---
67---- Rock Creek	D	None----	---	---	>6.0	---	---
68*:							
Rubble land.							
Rock outcrop.							
69---- Umapine Variant	C	Rare----	Brief----	Jan-Apr	1.5-3.0	Perched	Nov-Jun
70---- Strat	B	None----	---	---	>6.0	---	---
71, 72---- Supplee	B	None----	---	---	>6.0	---	---
73---- Timentwa	B	None----	---	---	>6.0	---	---
74---- Touhey	B	None----	---	---	>6.0	---	---
75---- Willis	C	None----	---	---	>6.0	---	---
76*. Xerofluvents							
77*. Xerorthents							

See footnote at end of table.

TABLE 19.--WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
78*:							
Zen	C	None	---	---	>6.0	---	---
Bakeoven	D	None	---	---	>6.0	---	---
Lickskillet	D	None	---	---	>6.0	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 20.--SOIL FEATURES

[The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
	In		In				
10*. Aquolls							
11---------- Badge	>60	---	---	---	Moderate-------	Moderate-------	Low.
12*:							
Bakeoven----------	4-12	Hard	---	---	Moderate-------	Moderate-------	Low.
Lickskillet----------	12-20	Hard	---	---	Moderate-------	Moderate-------	Low.
13*:							
Bakeoven----------	4-12	Hard	---	---	Moderate-------	Moderate-------	Low.
Touhey----------	>60	---	---	---	Moderate-------	Moderate-------	Low.
14, 15---------- Beverly	>60	---	---	---	Low----------	Moderate-------	Low.
16*:							
Broadax----------	>60	---	---	---	High----------	High----------	Low.
Condon----------	20-40	Hard	---	---	High----------	Moderate-------	Low.
17, 18---------- Burbank	>60	---	---	---	Low----------	High----------	Low.
19, 20, 21---------- Burch	>60	---	---	---	Moderate-------	Moderate-------	Low.
22, 23, 24---------- Cashmere	>60	---	---	---	Moderate-------	Moderate-------	Moderate.
25, 26, 27, 28---------- Cashmont	>60	---	---	---	Moderate-------	Moderate-------	Low.
29, 30---------- Cashmont Variant	>60	---	---	---	Moderate-------	Moderate-------	Low.
31---------- Chelan	>60	---	---	---	Moderate-------	Moderate-------	Low.
32*:							
Chelan---------- (3 to 30 percent slopes)	>60	---	---	---	Moderate-------	Moderate-------	Low.
Chelan---------- (30 to 65 percent slopes)	>60	---	---	---	Moderate-------	Moderate-------	Low.
33*:							
Chelan---------- (3 to 30 percent slopes)	>60	---	---	---	Moderate-------	High----------	Low.
Chelan---------- (30 to 65 percent slopes)	>60	---	---	---	Moderate-------	Moderate-------	Low.

See footnote at end of table.

TABLE 20.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
	In		In				
34*:							
Condon	20-40	Hard	---	---	High	Moderate	Low.
Rock Creek	8-20	Hard	---	---	Moderate	Moderate	Low.
Broadax	>60	---	---	---	High	High	Low.
35*:							
Cordy (3 to 30 percent slopes)	>60	---	---	---	Moderate	Moderate	Low.
Cordy (30 to 55 percent slopes)	>60	---	---	---	Moderate	Moderate	Low.
36*:							
Cordy	>60	---	---	---	Moderate	Moderate	Low.
Rock Creek	8-20	Hard	---	---	Moderate	Moderate	Low.
37--Dinkels	40-60	Hard	---	---	Moderate	Moderate	Moderate.
38--Dougville	>60	---	---	---	Moderate	Moderate	Low.
39, 40--Ellisforde	>60	---	---	---	Moderate	High	Low.
41*:							
Ellisforde (15 to 30 percent slopes)	>60	---	---	---	Moderate	High	Low.
Ellisforde (30 to 60 percent slopes)	>60	---	---	---	Moderate	High	Low.
42*:							
Entiat	12-20	Soft	---	---	Moderate	Moderate	Low.
Rock outcrop.							
43--Esquatzel	>60	---	---	---	Moderate	High	Low.
44--Finley	>60	---	---	---	Moderate	Moderate	Low.
45*, 46*. Haploxerolls							
47--Heytou	>60	---	---	---	Moderate	High	Low.
48*:							
Kiona	>60	---	---	---	Moderate	High	Low.
Rubble land.							
49, 50--Magallon	>60	---	---	---	Low	High	Low.

See footnote at end of table.

TABLE 20.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
	In		In				
51---------- Malaga	>60	---	---	---	Low----------	Moderate-------	Low.
52---------- Malaga	>60	---	---	---	Low----------	Moderate-------	Low.
53*. Pits							
54, 55, 56, 57---------- Pogue	>60	---	---	---	Moderate-------	Moderate-------	Low.
58, 59, 60---------- Pogue	>60	---	---	---	Moderate-------	Moderate-------	Low.
61---------- Pogue	>60	---	---	---	Moderate-------	Moderate-------	Low.
62, 63---------- Quincy	>60	---	---	---	Low----------	Moderate-------	Low.
64*:							
Ralls----------	>60	---	---	---	Low----------	High----------	Low.
Renslow----------	>60	---	---	---	High----------	High----------	Low.
Bakeoven----------	4-12	Hard	---	---	Moderate-------	Moderate-------	Low.
65*:							
Renslow---------- (0 to 15 percent slopes)	>60	---	---	---	High----------	High----------	Low.
Dougville----------	>60	---	---	---	Moderate-------	Moderate-------	Low.
Renslow---------- (15 to 30 percent slopes)	>60	---	---	---	High----------	High----------	Low.
66*:							
Renslow----------	>60	---	---	---	High----------	High----------	Low.
Zen----------	20-40	Hard	---	---	Moderate-------	Moderate-------	Low.
67---------- Rock Creek	8-20	Hard	---	---	Moderate-------	Moderate-------	Low.
68*:							
Rubble land.							
Rock outcrop.							
69---------- Umapine Variant	>60	---	20-40	Thin	High----------	High----------	Low.
70---------- Strat	>60	---	---	---	Moderate-------	Moderate-------	Low.
71, 72---------- Supplee	>60	---	---	---	Moderate-------	Moderate-------	Low.
73---------- Timentwa	>60	---	40-55	Thin	Moderate-------	High----------	Low.

See footnote at end of table.

TABLE 20.--SOIL FEATURES--Continued

Soil name and map symbol	Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
	In		In				
74---------- Touhey	>60	---	---	---	Moderate-------	Moderate-------	Low.
75---------- Willis	>60	---	20-40	Thick	Moderate-------	High----------	Low.
76*. Xerofluvents							
77*. Xerorthents							
78*: Zen----------	20-40	Hard	---	---	Moderate-------	Moderate-------	Low.
Bakeoven----------	4-12	Hard	---	---	Moderate-------	Moderate-------	Low.
Lickskillet----------	12-20	Hard	---	---	Moderate-------	Moderate-------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 21.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Badge	Loamy-skeletal, mixed, mesic Typic Argixerolls
Bakeoven	Loamy-skeletal, mixed, mesic Lithic Haploxerolls
Beverly	Sandy-skeletal, mixed, mesic Xeric Torrifluvents
Broadax	Fine-silty, mixed, mesic Calcic Argixerolls
Burbank	Sandy-skeletal, mixed, mesic Xeric Torriorthents
Burch	Coarse-loamy, mixed, mesic Aridic Haploxerolls
Cashmere	Coarse-loamy, mixed, mesic Aridic Haploxerolls
Cashmont	Coarse-loamy, mixed, mesic Aridic Haploxerolls
Cashmont Variant	Loamy-skeletal, mixed, mesic Aridic Haploxerolls
Chelan	Medial, mesic Andic Xerochrepts
Condon	Fine-silty, mixed, mesic Typic Haploxerolls
Cordy	Fine-loamy, mixed, frigid Typic Haploxerolls
Dinkels	Coarse-loamy, mixed, frigid Typic Haploxerolls
Dougville	Coarse-loamy, mixed, mesic Aridic Haploxerolls
Ellisforde	Coarse-silty, mixed, mesic Calciorthidic Haploxerolls
Entiat	Loamy-skeletal, mixed, mesic, shallow Aridic Haploxerolls
Esquatzel	Coarse-silty, mixed, mesic Torrifluventic Haploxerolls
Finley	Loamy-skeletal, mixed, mesic Xerollic Camborthids
Heytou	Loamy-skeletal, mixed, mesic Aridic Haploxerolls
Kiona	Loamy-skeletal, mixed, nonacid, mesic Xeric Torriorthents
Lickskillet	Loamy-skeletal, mixed, mesic Lithic Haploxerolls
Magallon	Sandy, mixed, mesic Aridic Haploxerolls
Malaga	Sandy-skeletal, mixed, mesic Xerollic Camborthids
Pogue	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Aridic Haploxerolls
Quincy	Sandy, mixed, mesic Xeric Torripsamments
Ralls	Fine-loamy, mixed, mesic Aridic Argixerolls
Renslow	Coarse-silty, mixed, mesic Aridic Calcic Argixerolls
Rock Creek	Clayey-skeletal, montmorillonitic, mesic Lithic Mollic Haploxeralfs
Strat	Loamy-skeletal, mixed, mesic Aridic Haploxerolls
Supplee	Medial over sandy or sandy-skeletal, mesic Andic Xerochrepts
Timentwa	Coarse-loamy, mixed, mesic Calcic Pachic Haploxerolls
Touhey	Coarse-loamy, mixed, mesic Aridic Duric Haploxerolls
Umapine Variant	Coarse-silty, mixed, mesic Haploxerollic Durorthids
Willis	Coarse-silty, mixed, mesic Orthidic Durixerolls
Zen	Fine-silty, mixed, mesic Aridic Haploxerolls

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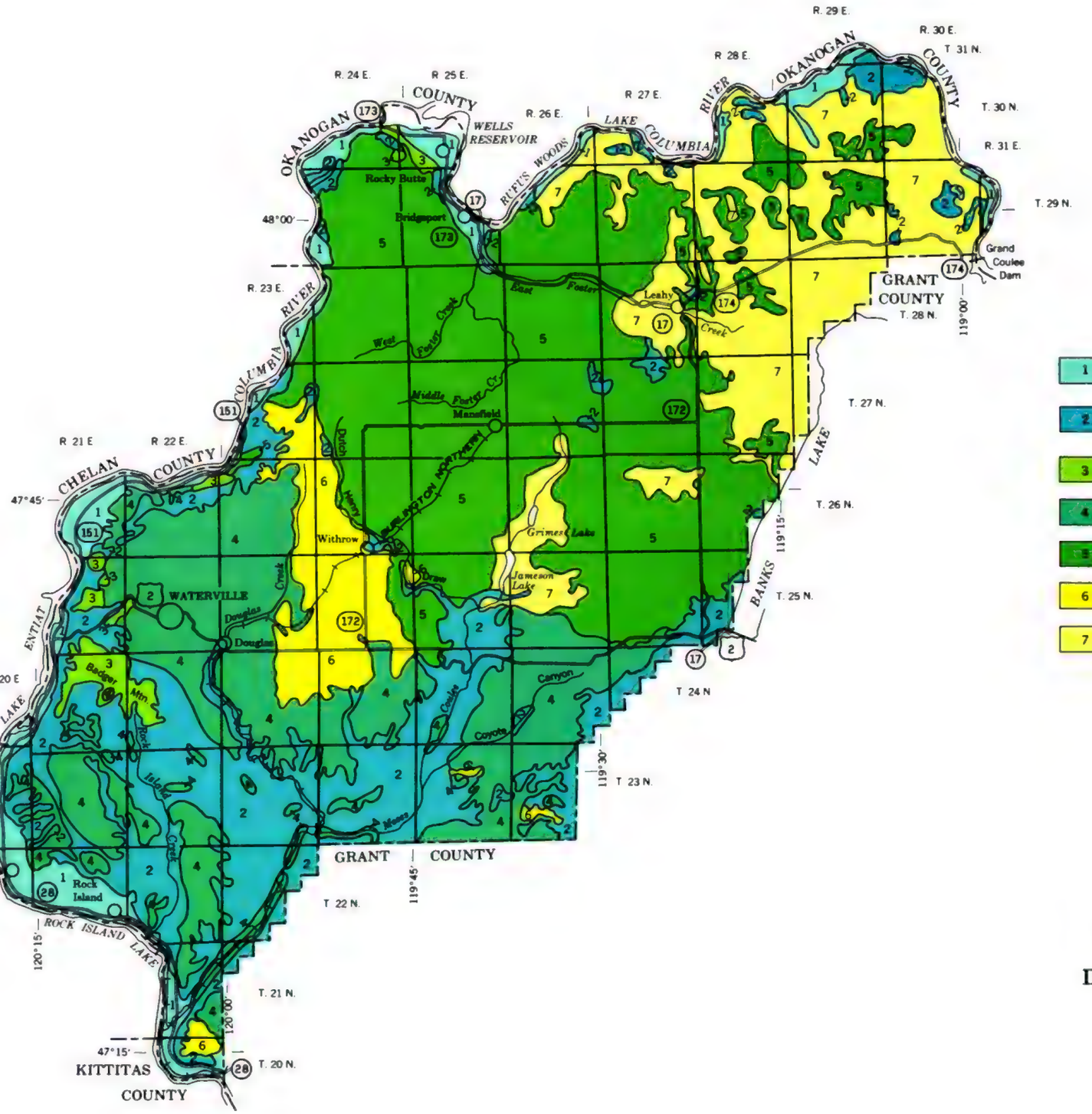


MAP UNITS

1. Pogue-Quincy-Xerorthents, very steep: Very deep, somewhat excessively drained, nearly level to very steep soils; on terraces and terrace escarpments
2. Bakeoven-Rock Creek-Lickskillet: Shallow, well drained, gently sloping to moderately steep soils; on basalt upland and plateaus, mountain side slopes and ridgetops
3. Dinkel-Cordy: Very deep and deep, well drained, undulating to very steep soils; on mountain slopes and side slopes
4. Renslow-Zen: Very deep, well drained and moderately deep, well drained, nearly level to moderately steep soils; on broad basalt plateaus
5. Touhey-Heytou: Very deep, well drained, nearly level to moderately steep soils; on broad uplands and basalt plateaus
6. Willis: Moderately deep, well drained, nearly level to moderately steep soils; on basalt plateaus
7. Bakoven-Touhey: Shallow and very deep, well drained, nearly level to steep soils; on broad basalt plateaus and uplands

Compiled 1980

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

WASHINGTON STATE UNIVERSITY
AGRICULTURAL RESEARCH CENTER

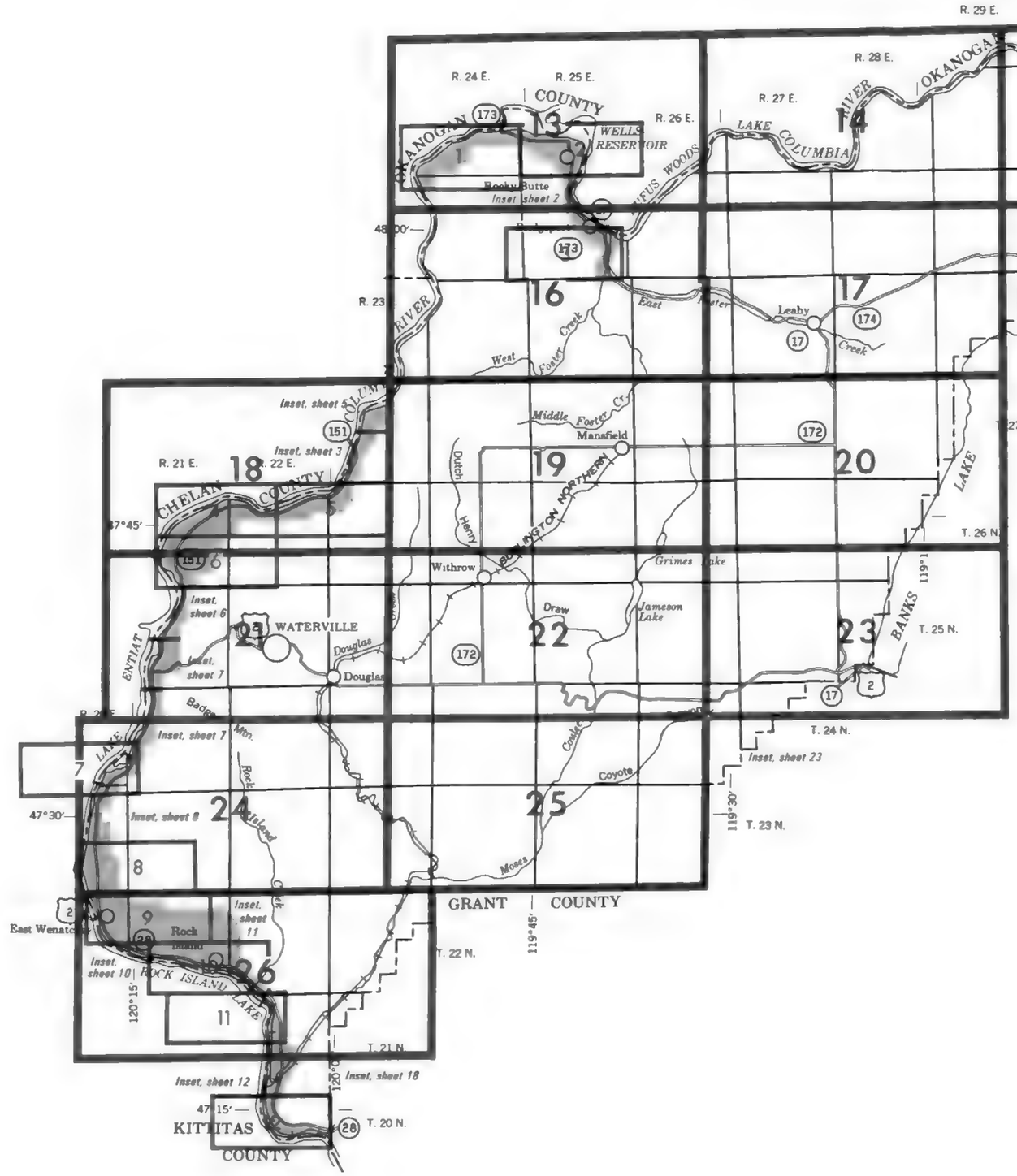
GENERAL SOIL MAP

DOUGLAS COUNTY, WASHINGTON

Scale 1:506,880
1 0 1 2 3 4 5 6 7 Miles

N

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



Area mapped at a scale of 1:63,360

Area mapped at a scale of 1:24,000

Original text from each individual map sheet read:
This map is compiled on 1975 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

INDEX TO MAP SHEETS

DOUGLAS COUNTY, WASHINGTON

Scale 1:506,880
1 0 1 2 3 4 5 6 7 Miles

N

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (70)
- Federal (410)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; W)

PITS

- Gravel pit (G.P.)
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; W)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (SvE 107)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown) (S)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

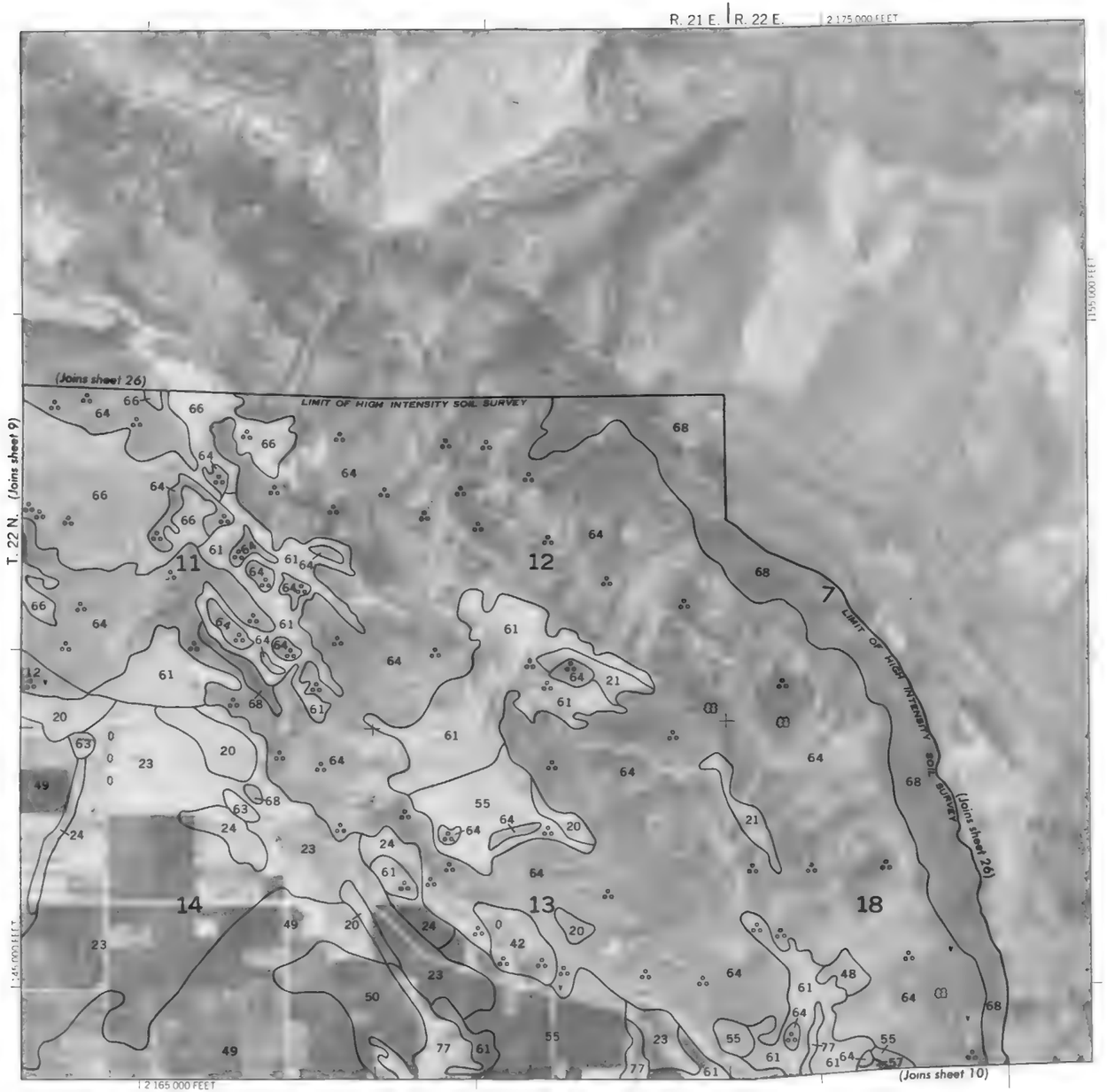
SOIL LEGEND

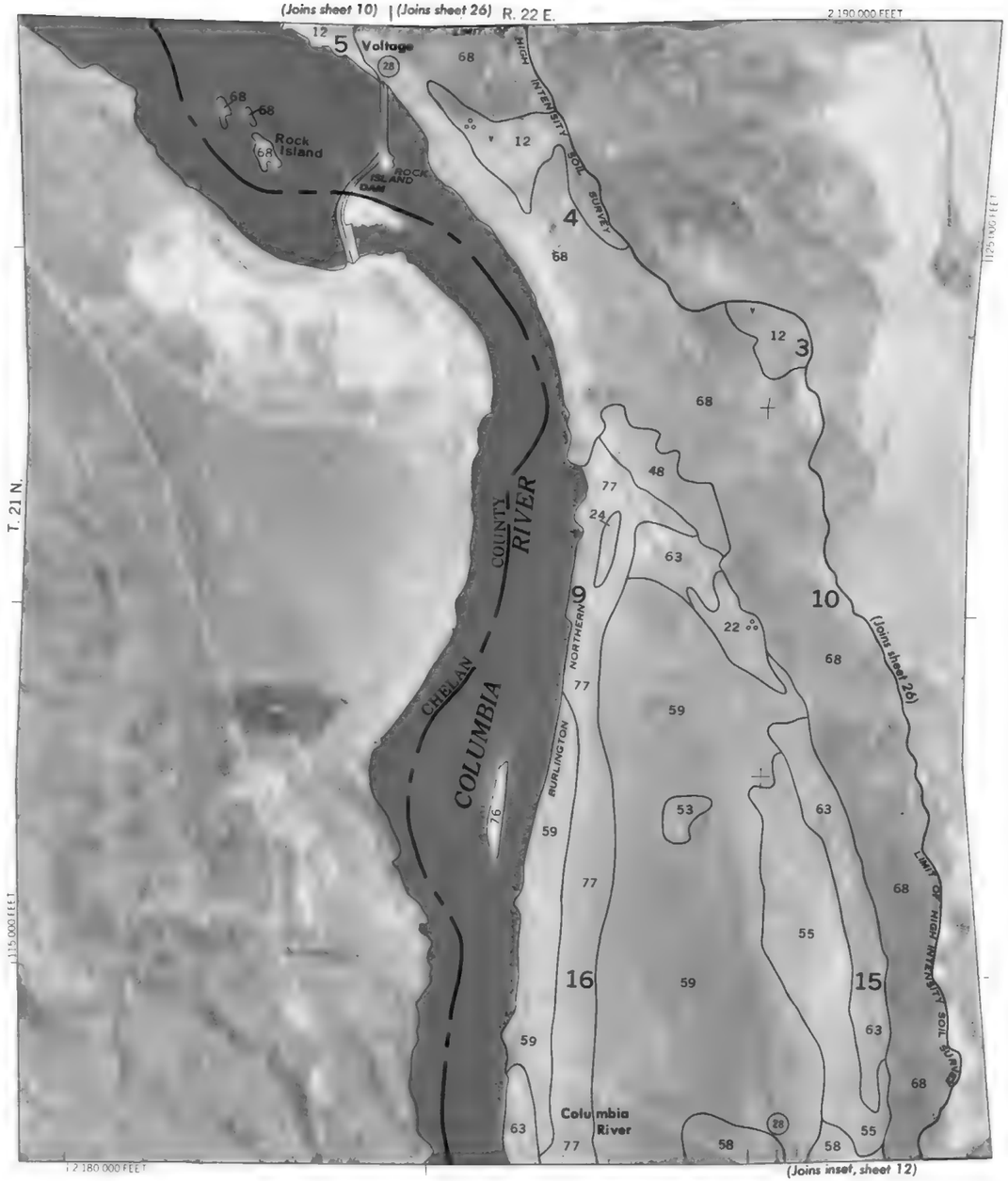
SYMBOL	NAME
10	Aquolls, nearly level*
11	Badge very cobbly silt loam, 25 to 65 percent slopes*
12	Bakeoven-Lickskillet association, gently sloping*
13	Bakeoven-Touhey association, gently sloping*
14	Beverly fine sandy loam, 0 to 8 percent slopes
15	Beverly cobbly fine sandy loam, 0 to 8 percent slopes
16	Broadax-Condon association, rolling*
17	Burbank loamy fine sand, 0 to 8 percent slopes
18	Burbank loamy fine sand, 8 to 25 percent slopes
19	Burch fine sandy loam, 8 to 15 percent slopes
20	Burch loam, 0 to 3 percent slopes
21	Burch loam, 3 to 8 percent slopes
22	Cashmere fine sandy loam, 0 to 3 percent slopes
23	Cashmere fine sandy loam, 3 to 8 percent slopes
24	Cashmere fine sandy loam, 8 to 15 percent slopes
25	Cashmont sandy loam, 3 to 8 percent slopes
26	Cashmont gravelly sandy loam, 3 to 8 percent slopes
27	Cashmont gravelly sandy loam, 8 to 15 percent slopes
28	Cashmont cobbly sandy loam, 3 to 15 percent slopes
29	Cashmont Variant, fine sandy loam, 3 to 8 percent slopes
30	Cashmont Variant, fine sandy loam, 8 to 15 percent slopes
31	Chelan very fine sandy loam, gravelly substratum, 0 to 8 percent slopes
32	Chelan association, bouldery*
33	Chelan association, steep*
34	Condon-Rock Creek-Broadax association, strongly sloping*
35	Cordy association, steep*
36	Cordy-Rock Creek association, steep*
37	Dinkels gravelly loam, 25 to 70 percent slopes
38	Dougville loam, 0 to 15 percent slopes*
39	Ellisforde fine sandy loam, 3 to 8 percent slopes
40	Ellisforde loam, 0 to 15 percent slopes*
41	Ellisforde association, steep
42	Entiat-Rock outcrop complex, steep*
43	Esquatzel loam*
44	Finley loam, 3 to 8 percent slopes*
45	Haploxerolls, nearly level*
46	Haploxerolls, gently sloping*
47	Heytou very stony loam, 0 to 30 percent slopes*
48	Kiona-Rubble land association, steep*
49	Magallon fine sandy loam, 3 to 8 percent slopes
50	Magallon fine sandy loam, 8 to 15 percent slopes
51	Malaga gravelly fine sandy loam, 0 to 8 percent slopes
52	Malaga cobbly fine sandy loam, 0 to 8 percent slopes
53	Pits, gravel
54	Pogue fine sandy loam, 0 to 3 percent slopes
55	Pogue fine sandy loam, 3 to 8 percent slopes
56	Pogue gravelly fine sandy loam, 8 to 15 percent slopes
57	Pogue gravelly fine sandy loam, 15 to 25 percent slopes
58	Pogue cobbly fine sandy loam, 0 to 15 percent slopes
59	Pogue extremely stony fine sandy loam, 3 to 25 percent slopes
60	Pogue bouldery fine sandy loam, 3 to 8 percent slopes
61	Pogue loam, 8 to 15 percent slopes
62	Quincy fine sand, 15 to 25 percent slopes
63	Quincy loamy fine sand, 0 to 15 percent slopes
64	Ralls-Renslow-Bakeoven association, steep*
65	Renslow-Dougville association, undulating*
66	Renslow-Zen association, undulating*
67	Rock Creek very cobbly silt loam, 3 to 30 percent slopes*
68	Rubble land-Rock outcrop complex*
69	Umapine Variant loam*
70	Strat very cobbly silt loam, 3 to 25 percent slopes*
71	Supplee very fine sandy loam, 3 to 8 percent slopes
72	Supplee very fine sandy loam, 8 to 15 percent slopes
73	Timentwa loam, 0 to 15 percent slopes*
74	Touhey loam, 0 to 15 percent slopes*
75	Willis silt loam, 3 to 15 percent slopes*
76	Xerofluvents, nearly level
77	Xerorthents, very steep
78	Zen-Bakeoven-Lickskillet association, undulating

* Broadly defined map units

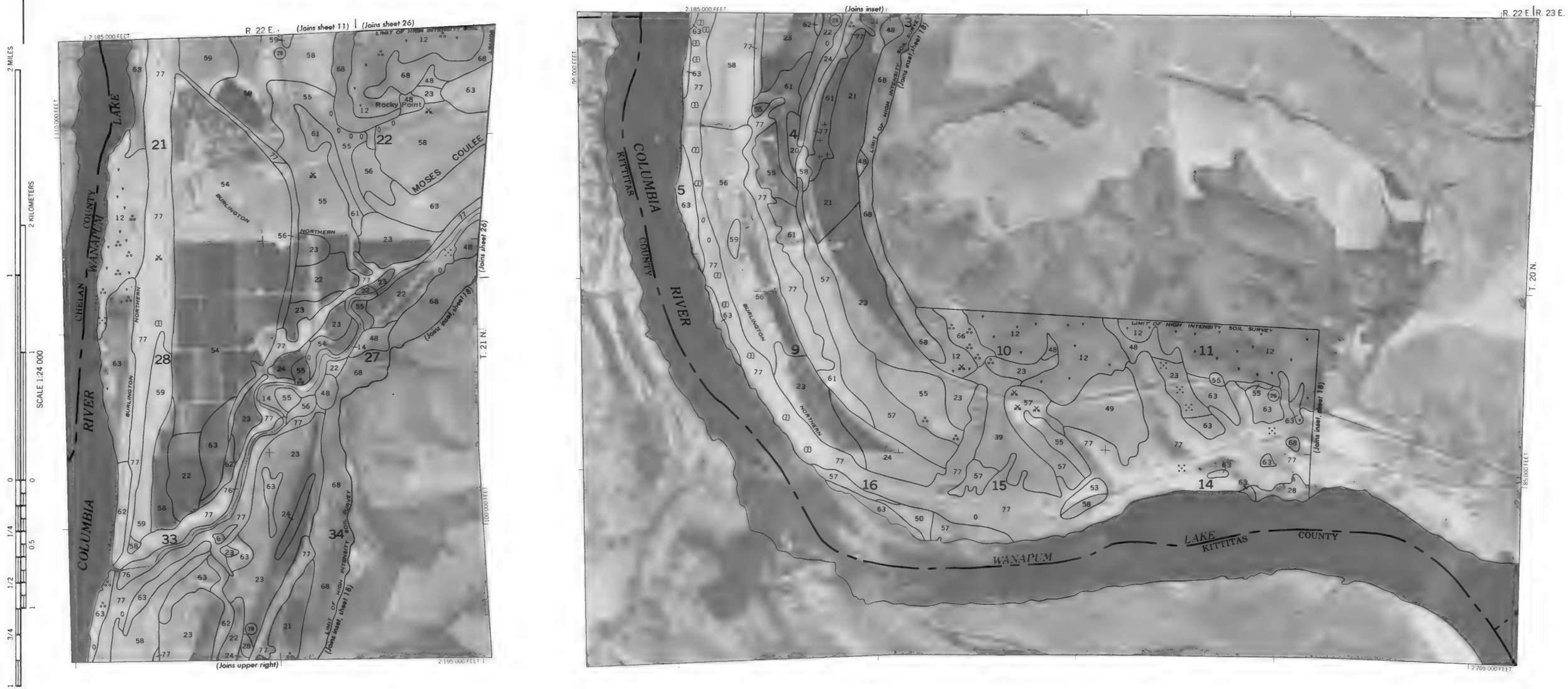
SOIL SURVEY OF DOUGLAS COUNTY, WASHINGTON — SHEET NUMBER 1


10
N
SCALE 1:24 000
2 MILES
2 KILOMETERS
(Joins sheet 9)
(Joins inset, sheet 11)
R. 21 E.
R. 22 E.
T. 22 N.
(Joins inset)
COLUMBIA
CHELAN
COUNTY
RIVER
water
Rock Island
BURLINGTON
NORTHERN
LIMIT OF IRRIGABILITY
(Joins sheet 26)
Lang Creek
(Joins sheet 11)
(Joins sheet 9)
R. 20 E.
R. 21 E.
(Joins upper left)
2 140 000 FEET
2 145 000 FEET
2 150 000 FEET
2 180 000 FEET
14 000 FEET
3000 AND 5000-FOOT GRID TICKS

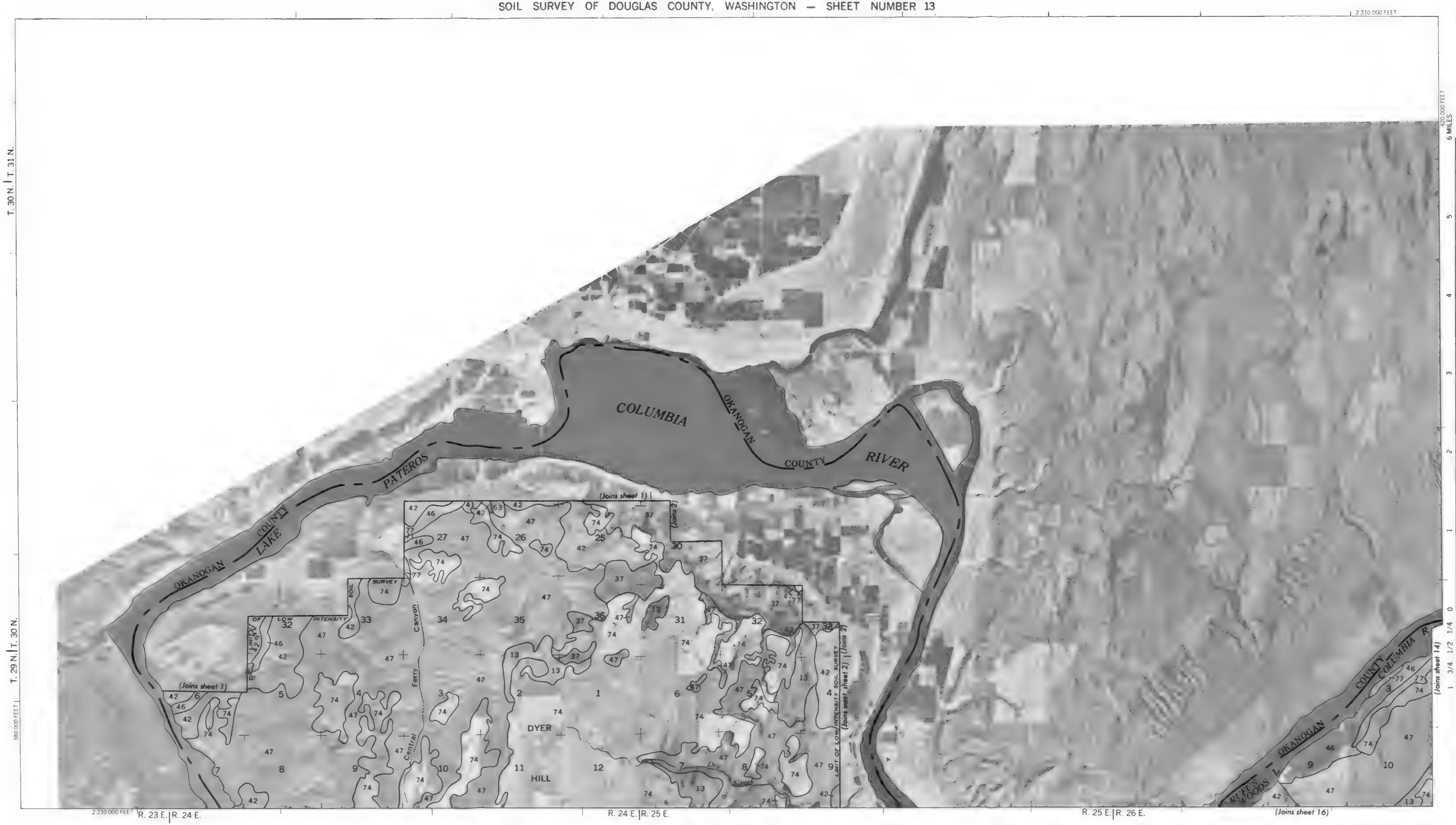

R. 21 E.
R. 22 E.
2 175 000 FEET
1 155 000 FEET
(Joins sheet 26)
(Joins sheet 9)
LIMIT OF HIGH INTENSITY SOIL SURVEY
T. 22 N.
11
12
13
14
18
7
(Joins sheet 26)
(Joins sheet 10)
2 165 000 FEET


(Joins sheet 10)
(Joins sheet 26)
R. 22 E.
2 190 000 FEET
1 175 000 FEET
T. 21 N.
Voltage
Rock Island
ROCK ISLAND DAM
HIGH INTENSITY SOIL SURVEY
CHELAN COUNTY
COLUMBIA RIVER
BURLINGTON NORTHERN
Columbia River
9
10
15
16
(Joins sheet 26)
LIMIT OF HIGH INTENSITY SOIL SURVEY
(Joins inset, sheet 12)
2 180 000 FEET

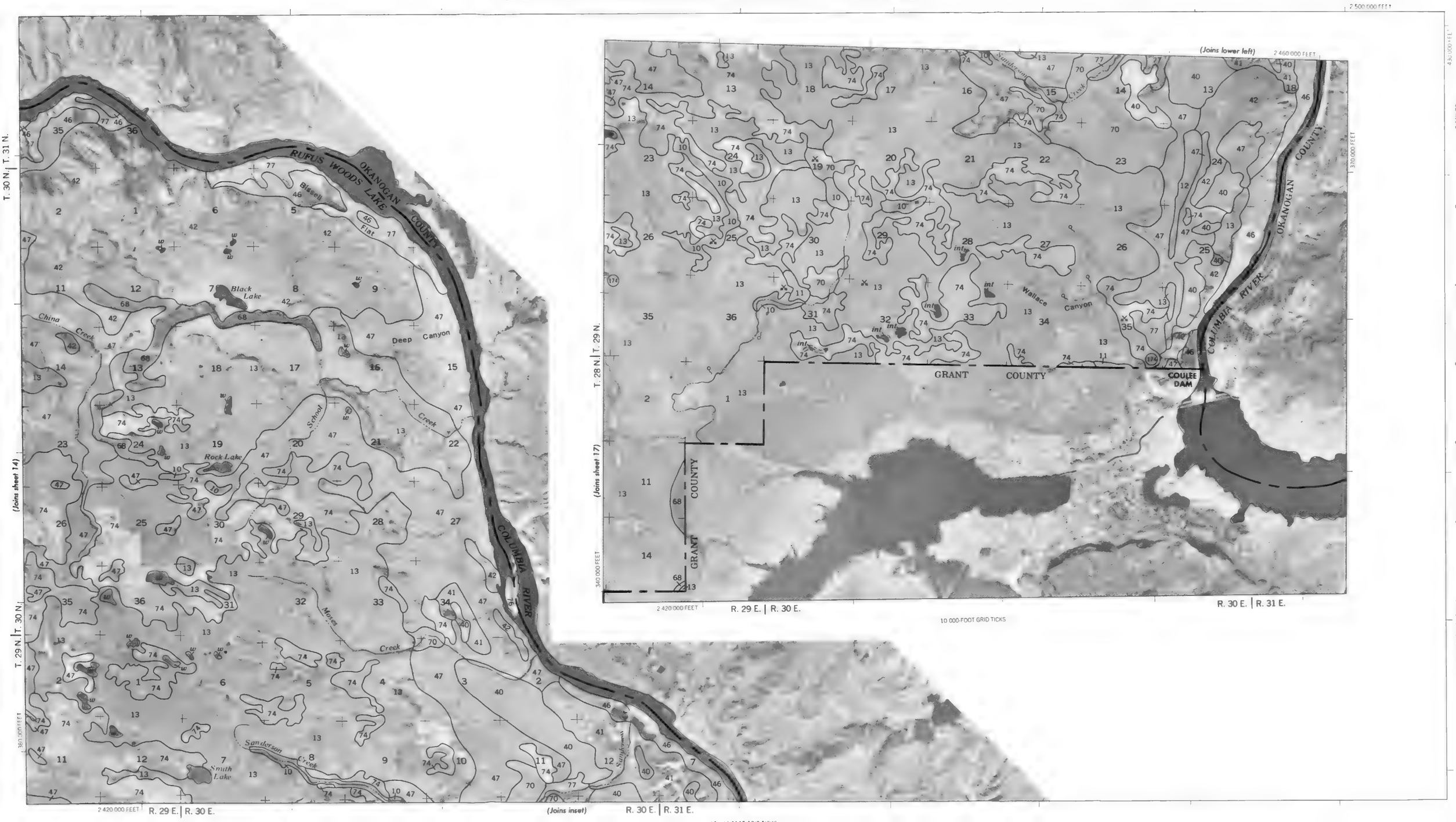

11
N
2 MILES
2 KILOMETERS
SCALE 1:24 000


12
N
2 MILES
2 KILOMETERS
SCALE 1:24 000
2 185 000 FEET
2 195 000 FEET
2 205 000 FEET
1 110 000 FEET
1 100 000 FEET
1 085 000 FEET
R. 22 E.
R. 23 E.
T. 21 N.
T. 20 N.
(Joins sheet 11)
(Joins sheet 26)
(Joins upper right)
(Joins inset)
(Joins inset, sheet 18)
LIMIT OF HIGH INTENSITY SOIL SURVEY
COLUMBIA RIVER
CHELAN COUNTY
WANAPUM LAKE
KITTITAS COUNTY
MOSES COULEE
Rocky Point
BURLINGTON NORTHERN
21
22
27
28
33
34
5
4
3
9
10
11
16
15
14

SOIL SURVEY OF DOUGLAS COUNTY, WASHINGTON — SHEET NUMBER 13

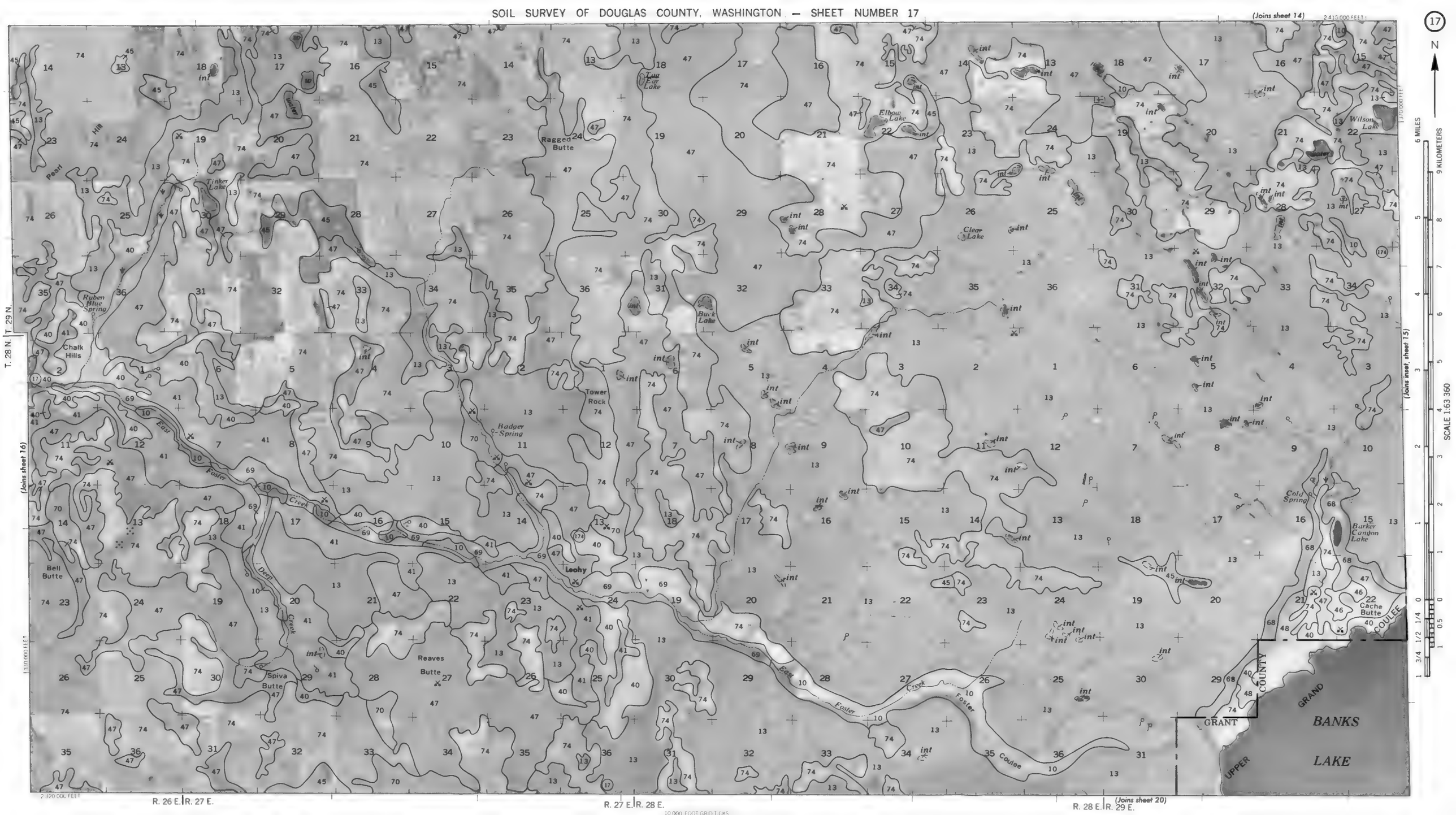


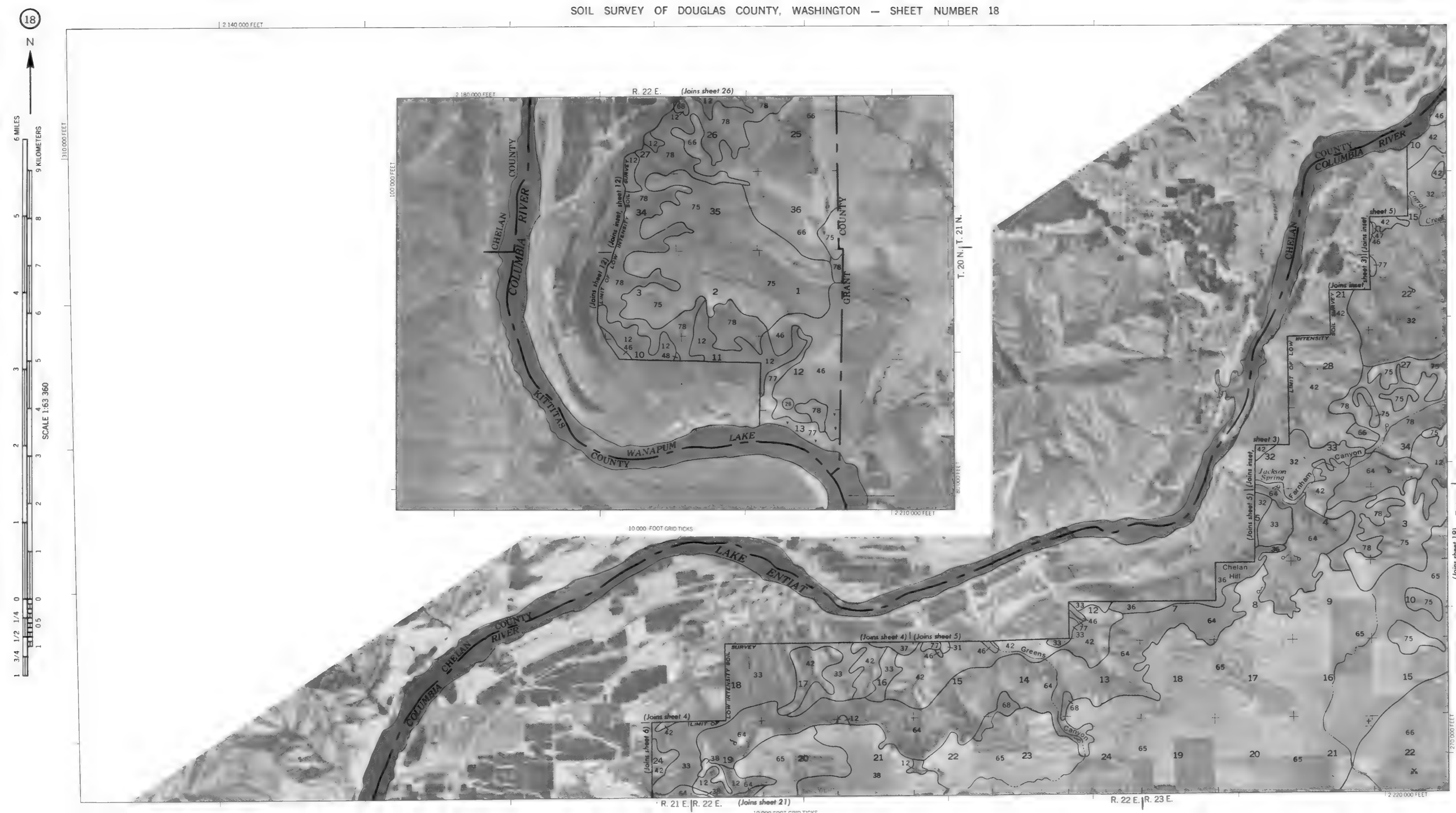

14
N
2 320 000 FEET
420 000 FEET
6 MILES
9 KILOMETERS
SCALE 1:63 360
OKANOGAN COUNTY
RUFUS WOODS LAKE
OKANOGAN RIVER
COLUMBIA RIVER
OKANOGAN RIVER
COUNTY WOODS LAKE
Lone Pine Lake
Judson Lake
Duley Lake
Allen Bar
Alameda Flat
China Creek
Twin Sisters Canyon
Strahl Canyon
Buck Canyon
Alder Canyon
Balloon Rock
(Joins sheet 13)
(Joins sheet 17)
(Joins sheet 15)
R. 26 E.
R. 27 E.
R. 28 E.
R. 29 E.
T. 31 N.
T. 30 N.
T. 29 N.
2 410 000 FEET

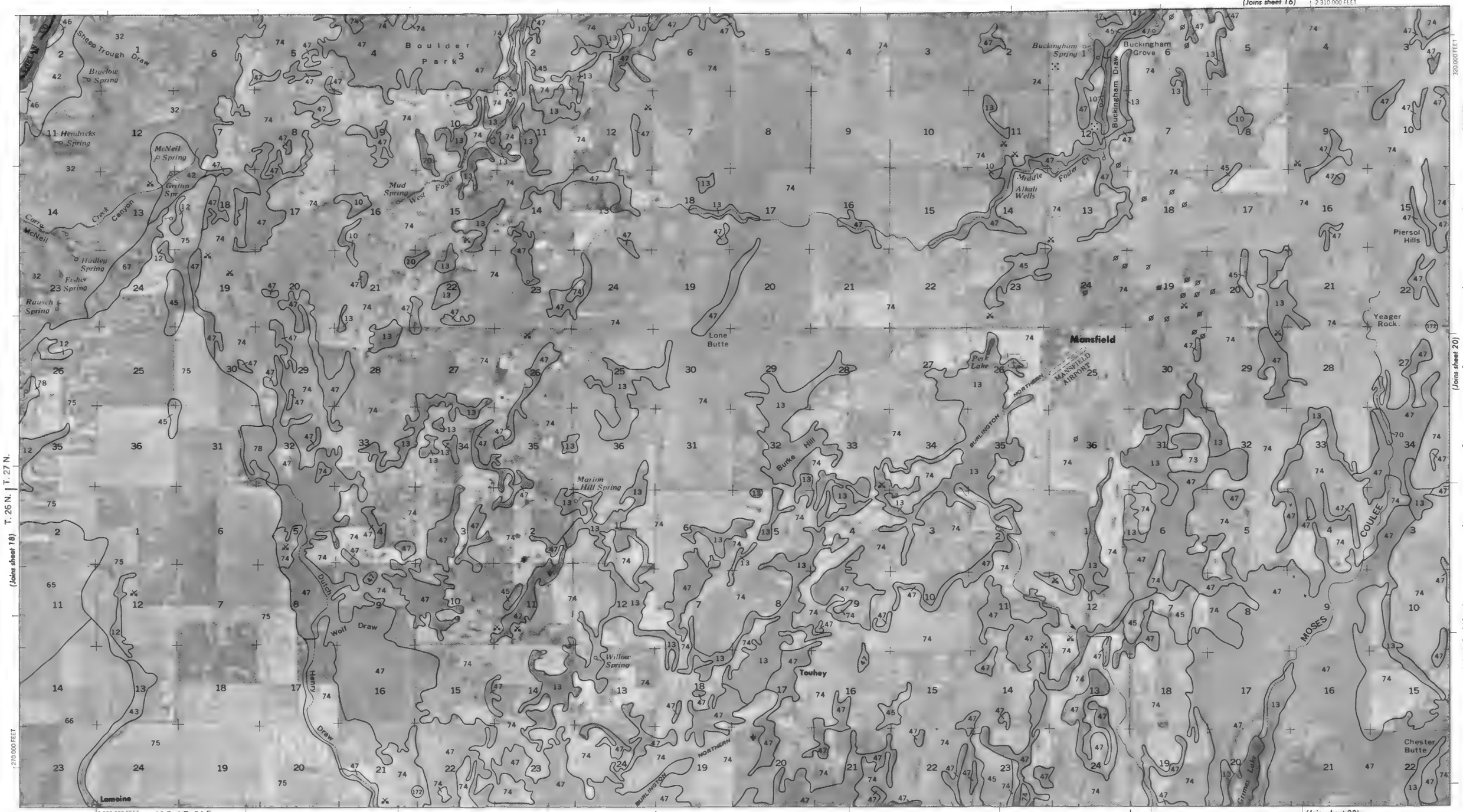

2 500 000 FEET
(Joins lower left)
2 460 000 FEET
T. 30 N. | T. 31 N.
T. 29 N. | T. 30 N.
T. 28 N. | T. 29 N.
(Joins sheet 14)
(Joins sheet 17)
380 000 FEET
340 000 FEET
370 000 FEET
430 000 FEET
2 420 000 FEET
R. 29 E. | R. 30 E.
R. 30 E. | R. 31 E.
(Joins inset)
10 000-FOOT GRID TICKS
RUFUS WOODS LAKE
OKANOGAN COUNTY
COLUMBIA RIVER
GRANT COUNTY
COULEE DAM
Black Lake
Rock Lake
Smith Lake
Deep Canyon
Wallace Canyon
China Creek
School Creek
Moses Creek
Sanderson Creek
Blissell Flat
N
6 MILES
9 KILOMETERS
SCALE 1:63 360


16
N
2 230 000 FEET
(Joins sheet 13)
370 000 FEET
LAKE PATEROS
OKANOGAN COUNTY
COLUMBIA RIVER
Ford Spring
The Horseshoe
Bonita Flats
Cold Springs Basin
WELLS DAM
Beard Lake
Skeleton Canyon
Columbia River
CHELAN COUNTY
Lake Entiat
Windsor Hill
Howard
Pattie Big Spring
Long Draw
Landingham Hill
Boulder Park
Alexander Lake
McLain Lake
Dezellem Lake
DRY HILL
Smith Draw
Rudd Lake
Eye Draw
Sourdough Flats
Middle Foster Ck.
West Foster Ck.
Carter Hill
SOIL SURVEY (Joins inset, sheet 2)
INTENSITY (Joins sh 3)
LOW
Sand Hill
LIMIT OF INTENSITY SOIL SURVEY
(Joins sheet 3)
Blue
RUFUS WOODS LAKE
CHIEF JOSEPH DAM
Foster Creek
Peaceful Valley
East Foster Creek
(Joins sheet 17)
T. 28 N.
T. 29 N.
330 000 FEET
2 310 000 FEET
(Joins sheet 19)
R. 23 E.
R. 24 E.
R. 25 E.
R. 26 E.
10 000-FOOT GRID TICKS
6 MILES
9 KILOMETERS
SCALE 1:63 360

SOIL SURVEY OF DOUGLAS COUNTY, WASHINGTON — SHEET NUMBER 17




18
N
SCALE 1:63 360
6 MILES
9 KILOMETERS
2 140 000 FEET
2 180 000 FEET
2 210 000 FEET
2 220 000 FEET
310 000 FEET
100 000 FEET
80 000 FEET
210 000 FEET
10 000 FOOT GRID TICKS
R. 22 E.
(Joins sheet 26)
T. 21 N.
T. 20 N.
CHELAN COUNTY
COLUMBIA RIVER
GRANT COUNTY
KITTITAS COUNTY
WANAPUM LAKE
LAKE ENTIAT
CHELAN COUNTY
COLUMBIA RIVER
(Joins sheet 12)
LIMIT OF LOW INTENSITY SOIL SURVEY
(Joins sheet 4)
(Joins sheet 5)
(Joins sheet 6)
(Joins sheet 21)
R. 21 E.
R. 22 E.
R. 23 E.
Chelan Hill
Jackson Spring
Farnham
Canyon
Greens
Canyon
Coral Creek

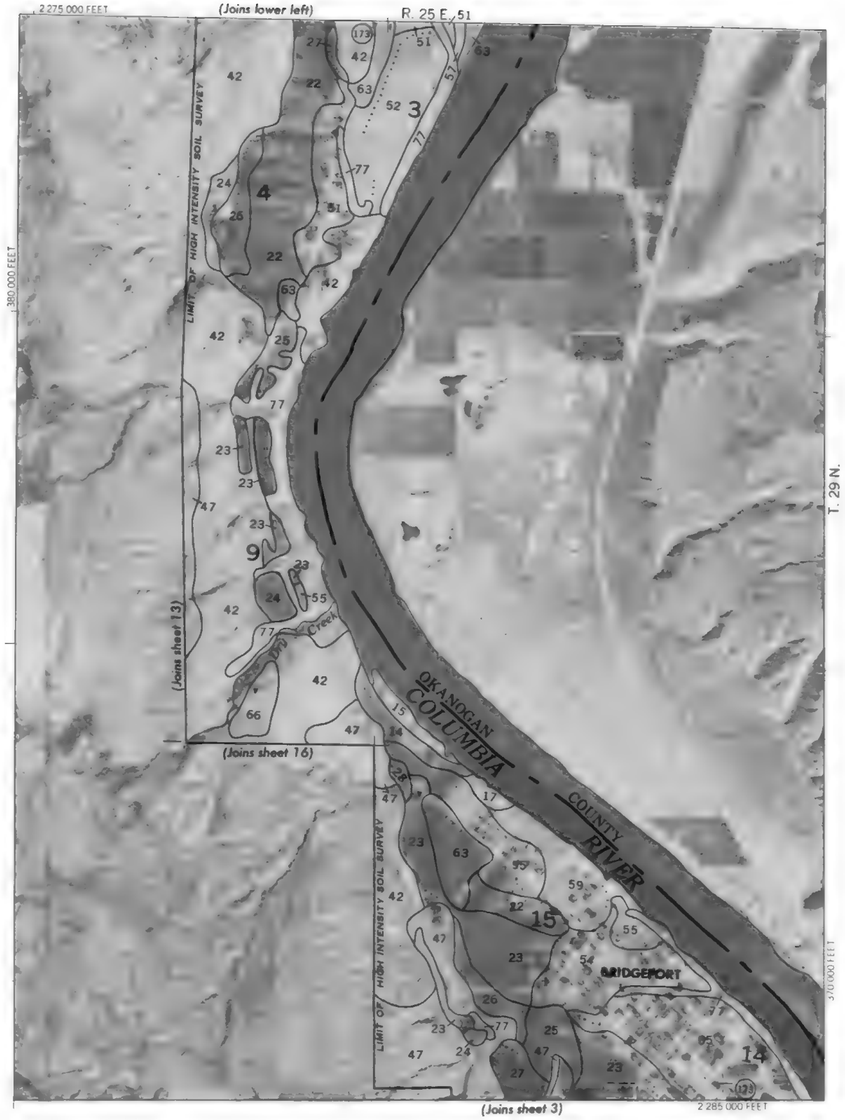

(Joins sheet 16)
2 310 000 FEET
320 000 FEET
Sheep Trough Draw
Bugbow Spring
Boulder Park
Buckingham Spring
Buckingham Grove
Buckingham Draw
Hendricks Spring
McNeil Spring
Griffin Spr.
Mud Spring
West Foster Cr.
Middle Foster Cr.
Alkali Wells
Corra McNeil
Creek Canyon
Hadley Spring
Fisher Spring
Rausch Spring
Lone Butte
Mansfield
Perk Lake
MANSFIELD AIRPORT
NORTHERN
BURLINGTON
Piersol Hills
Yeager Rock
Burke Hill
Marion Hill Spring
Dutch
Wolf Draw
Henry
Draw
Willow Spring
Touhey
COULEE
MOSES
Chester Butte
Crimes Lake
Lamoine
(Joins sheet 18)
T. 27 N.
T. 26 N.
270 000 FEET
2 230 000 FEET
R. 23 E.
R. 24 E.
R. 25 E.
R. 26 E.
(Joins sheet 22)
(Joins sheet 20)
N
6 MILES
9 KILOMETERS
SCALE 1:63 360
1 3/4 1/2 1/4 0
1 0.5 0

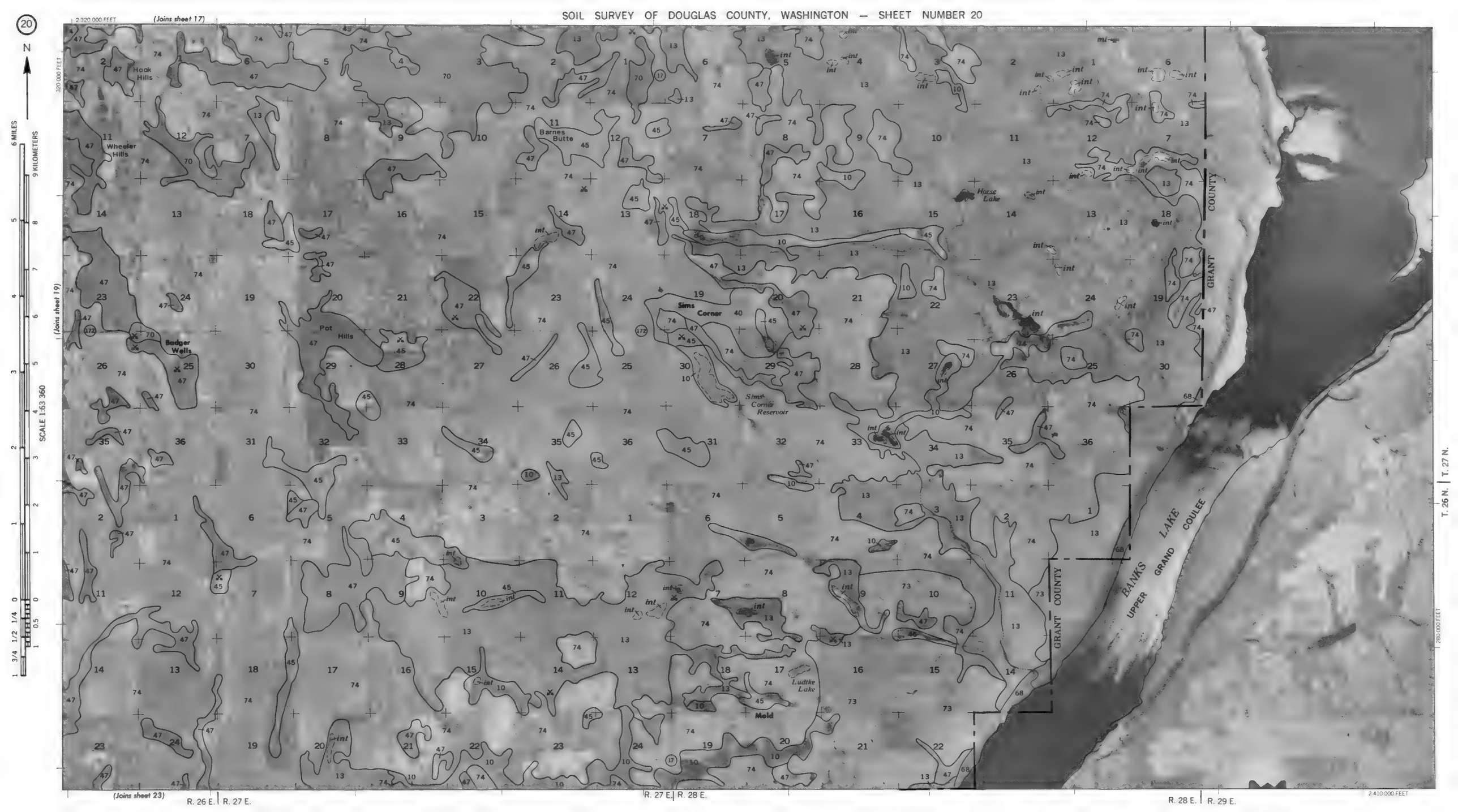
(2)

N

SCALE 1:24 000

2 MILES 1 0 1 2 KILOMETERS




2 320 000 FEET
(Joins sheet 17)
320 000 FEET
(Joins sheet 19)
(Joins sheet 23)
2 410 000 FEET
280 000 FEET
N
SCALE 1:63 360
6 MILES
9 KILOMETERS
Hook Hills
Wheeler Hills
Barnes Butte
Horse Lake
Sims Corner
Sims Corner Reservoir
Pot Hills
Badger Wells
Ludtke Lake
Mold
GRANT COUNTY
GRANT COUNTY
BANKS LAKE
UPPER GRAND COULEE
R. 26 E.
R. 27 E.
R. 27 E.
R. 28 E.
R. 28 E.
R. 29 E.
T. 26 N.
T. 27 N.

(Joins sheet 18)

2 220 000 FEET

21

N

6 MILES

9 KILOMETERS

SCALE 1:63 360

T. 25 N. | T. 26 N.

T. 24 N. | T. 25 N.

220 000 FEET

2 140 000 FEET

R. 21 E. | R. 22 E.

R. 22 E. | R. 23 E.

(Joins sheet 22)

(Joins sheet 24)

CHELAN COUNTY COLUMBIA RIVER

LAKE ENTIAT

(Joins sheet 6)

Browns Canyon

(Joins inset, sheet 6)

(Joins inset A, sheet 7)

LIMIT OF LOW INTENSITY SOIL SURVEY

Carpender Springs

CORBALEY

CANYON

Pine

(Joins inset A, sheet 7)

(Joins inset B, sheet 7)

BADGER MOUNTAIN

McGinnis Canyon

Kummer Draw

WATERVILLE PLATEAU

WATERVILLE AIRPORT

Waterville (county seat)

Standpipe Hill

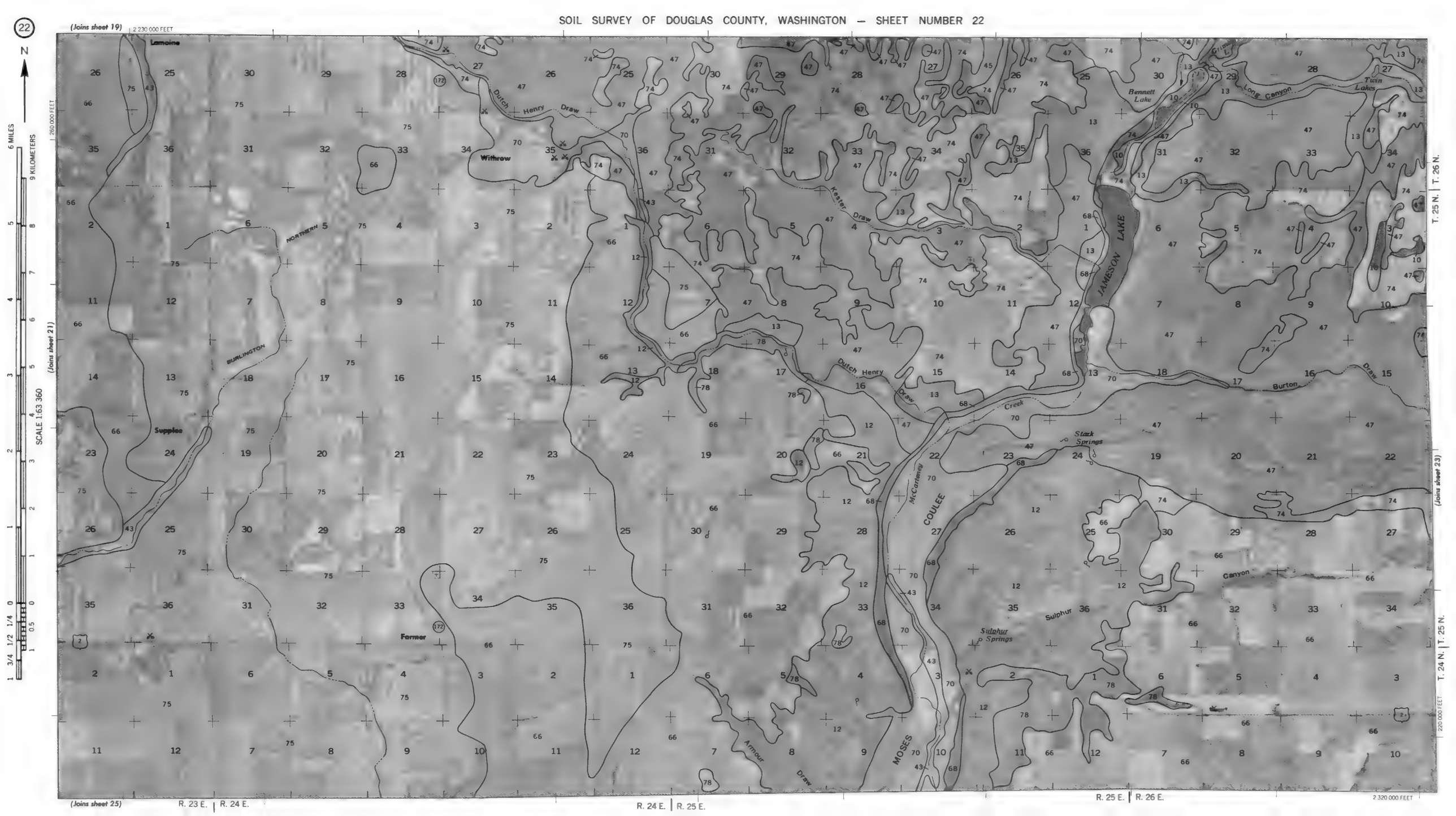
Douglas Draw

Douglas Creek

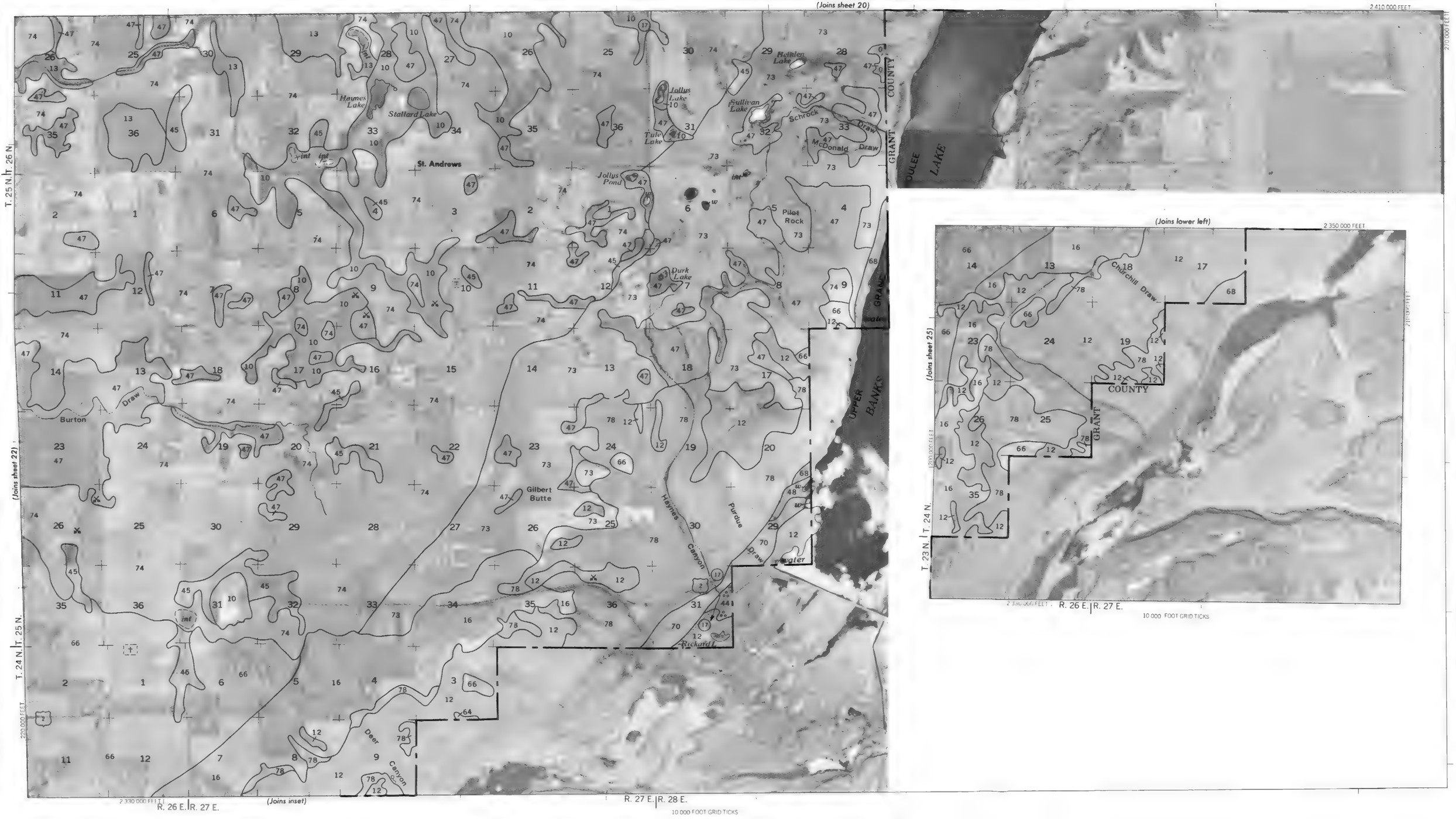
BURLINGTON NORTHERN

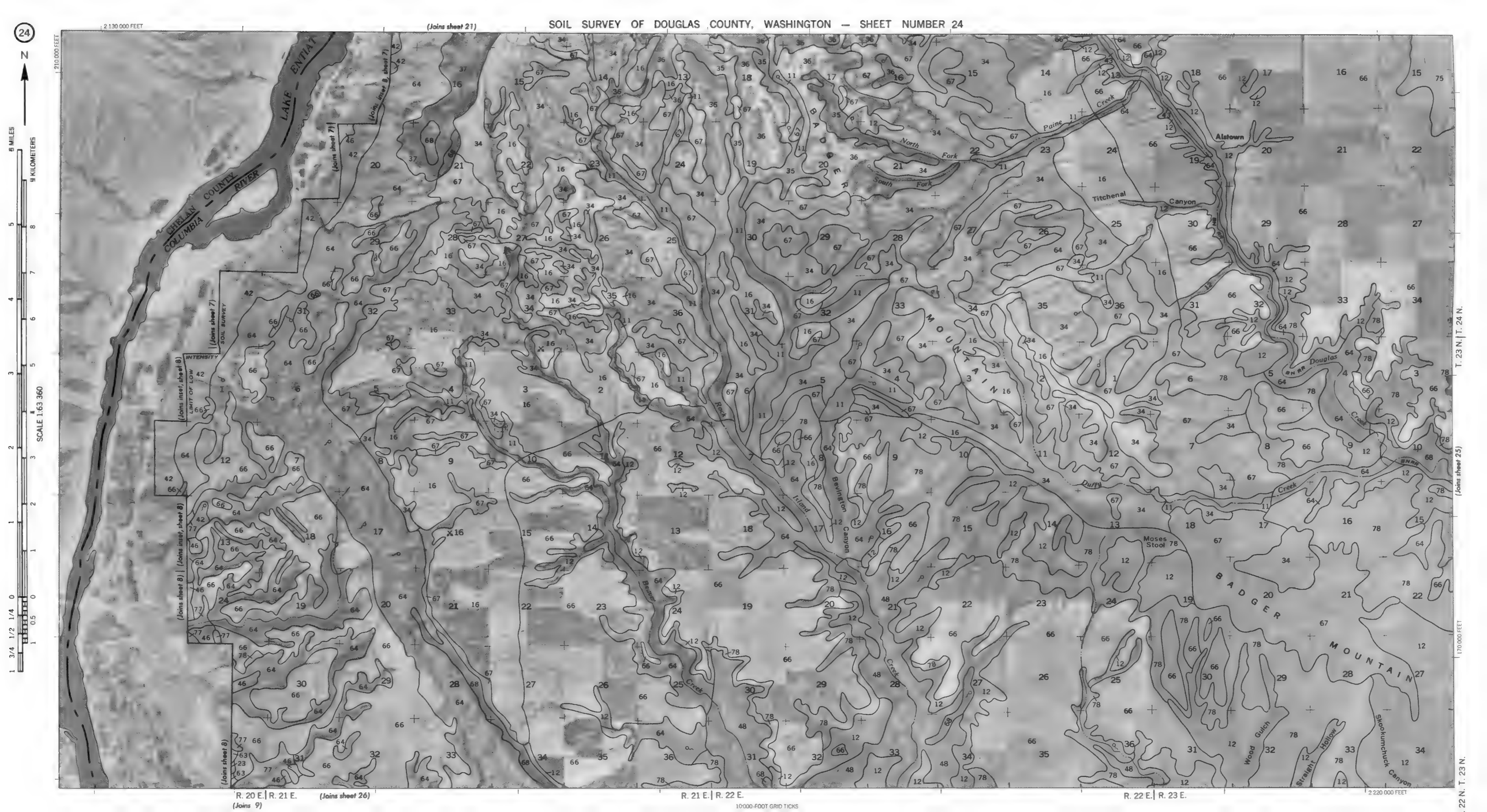
BN RR

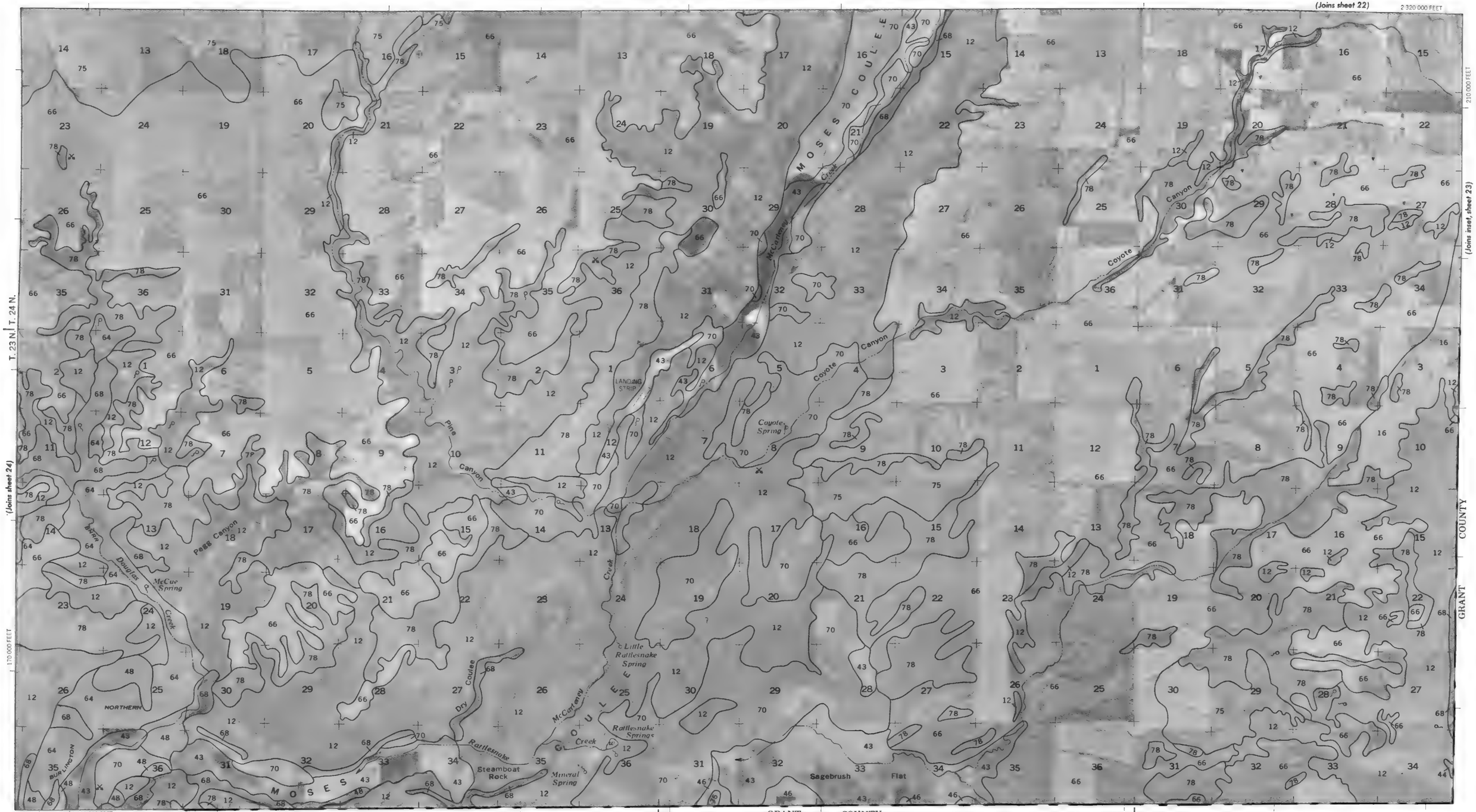
Ruud Canyon

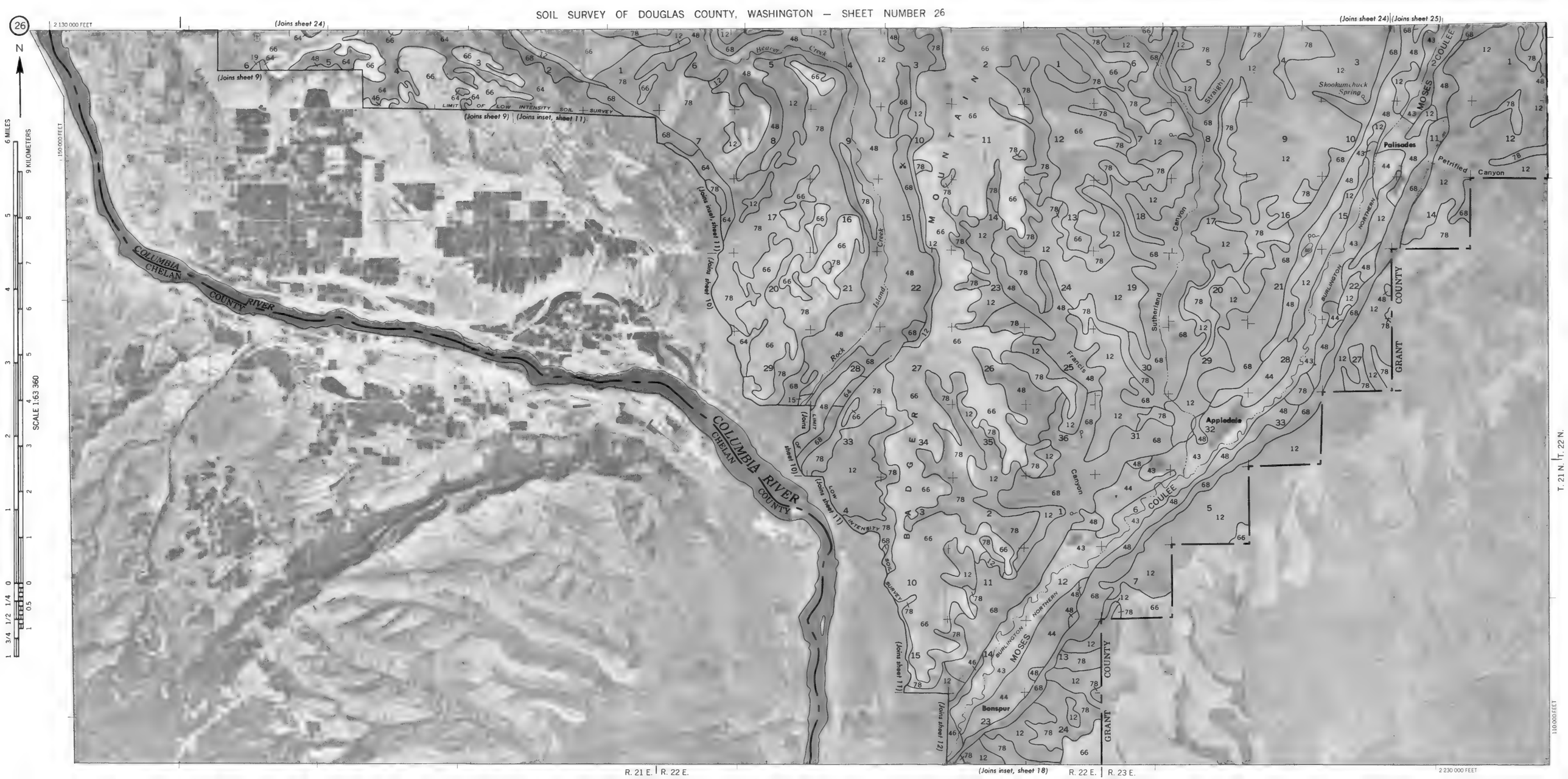

22
N
(Joins sheet 19)
2 230 000 FEET
260 000 FEET
(Joins sheet 21)
SCALE 1:63 360
6 MILES
9 KILOMETERS
1 3/4 1/2 1/4 0
1 0.5 0
Lamoine
Withrow
Dutch Henry Draw
Kester Draw
JAMESON LAKE
Bennett Lake
Long Canyon
Twin Lakes
NORTHERN
BURLINGTON
Supplee
Dutch Henry Draw
Burton Draw
Creek
Stack Springs
McCartney
COULEE
Canyon
Sulphur
Sulphur Springs
Armour Draw
MOSES
Farmer
T. 26 N.
T. 25 N.
T. 24 N.
(Joins sheet 23)
(Joins sheet 25)
R. 23 E.
R. 24 E.
R. 25 E.
R. 26 E.
2 320 000 FEET
220 000 FEET

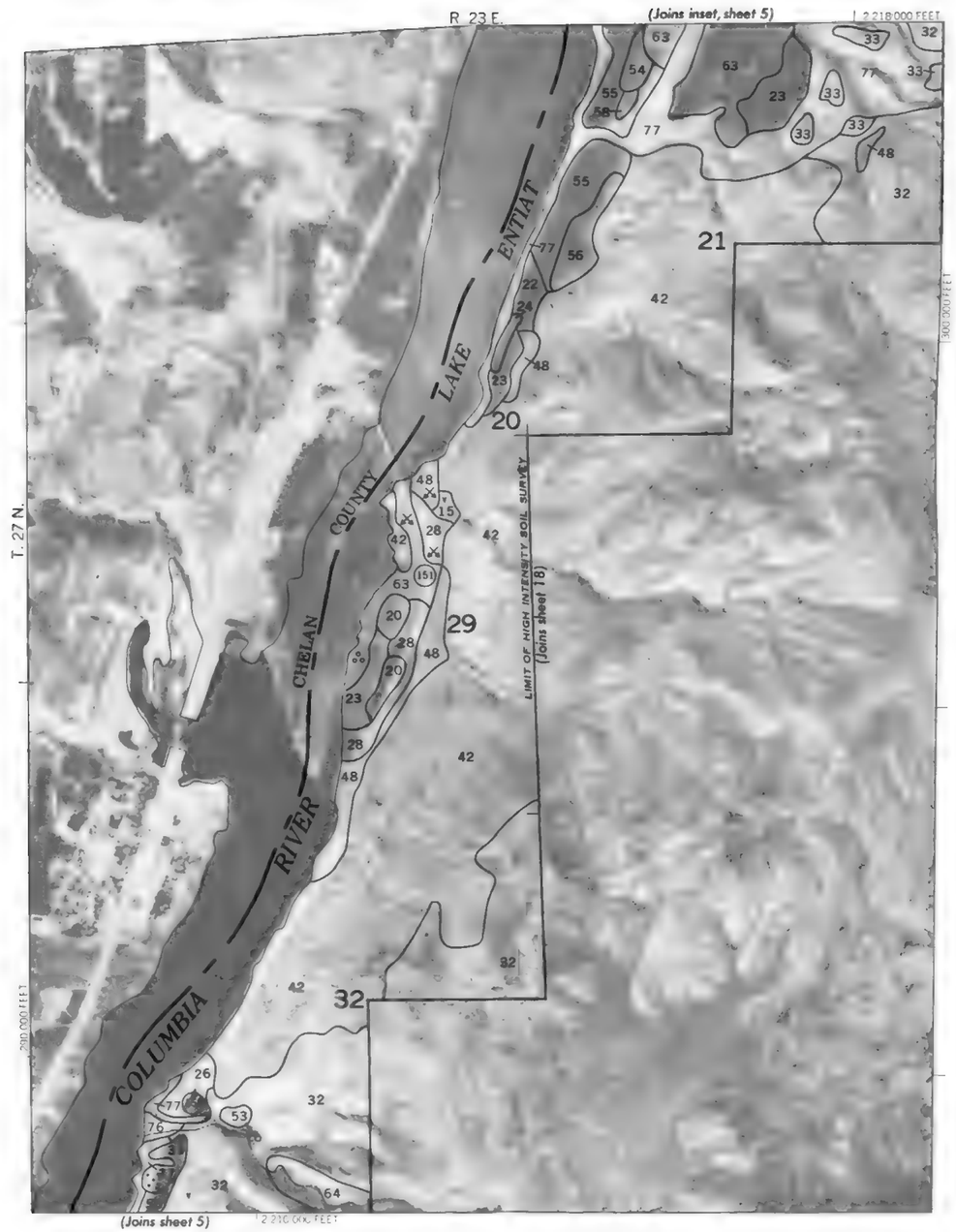
(Joins sheet 20)




SOIL SURVEY OF DOUGLAS COUNTY, WASHINGTON — SHEET NUMBER 24
24
N
SCALE 1:63 360
5 MILES
5 KILOMETERS
2 130 000 FEET
2 220 000 FEET
210 000 FEET
170 000 FEET
(Joins sheet 21)
(Joins sheet 25)
(Joins sheet 26)
(Joins 9)
(Joins sheet 7)
(Joins sheet 8)
(Joins inset, sheet 8)
LAKE ENTIAT
CHELAN COUNTY
COLUMBIA RIVER
SOIL SURVEY
INTENSITY
LIMIT OF LOW
BADGER MOUNTAIN
Rock Island
Bevington Canyon
Beaver Creek
Paine Creek
North Fork
South Fork
Titchenal Canyon
Alstown
Douglas Creek
Duffy Creek
Moses Stool
Wood Gulch
Straight Hollow
Skookumchuck Canyon
R. 20 E.
R. 21 E.
R. 22 E.
R. 23 E.
T. 24 N.
T. 23 N.
T. 22 N.
10000-FOOT GRID TICKS


(Joins sheet 22)
2 320 000 FEET
210 000 FEET
(Joins inset, sheet 23)
T. 24 N.
T. 23 N.
(Joins sheet 24)
170 000 FEET
(Joins sheet 26)
2 230 000 FEET
R. 23 E.
R. 24 E.
R. 25 E.
R. 26 E.
GRANT COUNTY
GRANT COUNTY
MOSES COULEE
McCartney Creek
Coyote Canyon
Coyote Spring
Pine Canyon
Peggs Canyon
Douglas Creek
McCue Spring
Little Rattlesnake Spring
Rattlesnake Spring
Rattlesnake Creek
Dry Coulee
Steamboat Rock
Mineral Spring
Sagebrush Flat
LANDING STRIP
NORTHERN PACIFIC
BURLINGTON
6 MILES
9 KILOMETERS
SCALE 1:63 360
1 3/4 1/2 1/4 0
1 0.5 0


26
2 130 000 FEET
150 000 FEET
N
6 MILES
9 KILOMETERS
SCALE 1:63 360
1 3/4 1/2 1/4 0
1 0.5 0
(Joins sheet 24)
(Joins sheet 9)
LIMIT OF LOW INTENSITY SOIL SURVEY
(Joins sheet 9) (Joins inset, sheet 11)
(Joins inset, sheet 11)
(Joins sheet 10)
COLUMBIA RIVER
CHELAN COUNTY
(Joins sheet 10)
(Joins sheet 11)
(Joins sheet 11)
(Joins sheet 12)
(Joins inset, sheet 18)
(Joins sheet 24) (Joins sheet 25)
Beaver Creek
Rock Island Creek
Skookumchuck Spring
Straight Canyon
Sutherland
Francis Canyon
Palisades
Petrified Canyon
Appledale
Bonspur
MOSES COULEE
BURLINGTON NORTHERN
GRANT COUNTY
R. 21 E.
R. 22 E.
R. 22 E.
R. 23 E.
T. 21 N.
T. 22 N.
2 230 000 FEET
110 000 FEET



3000 AND 5000-FOOT GRID TICKS

3

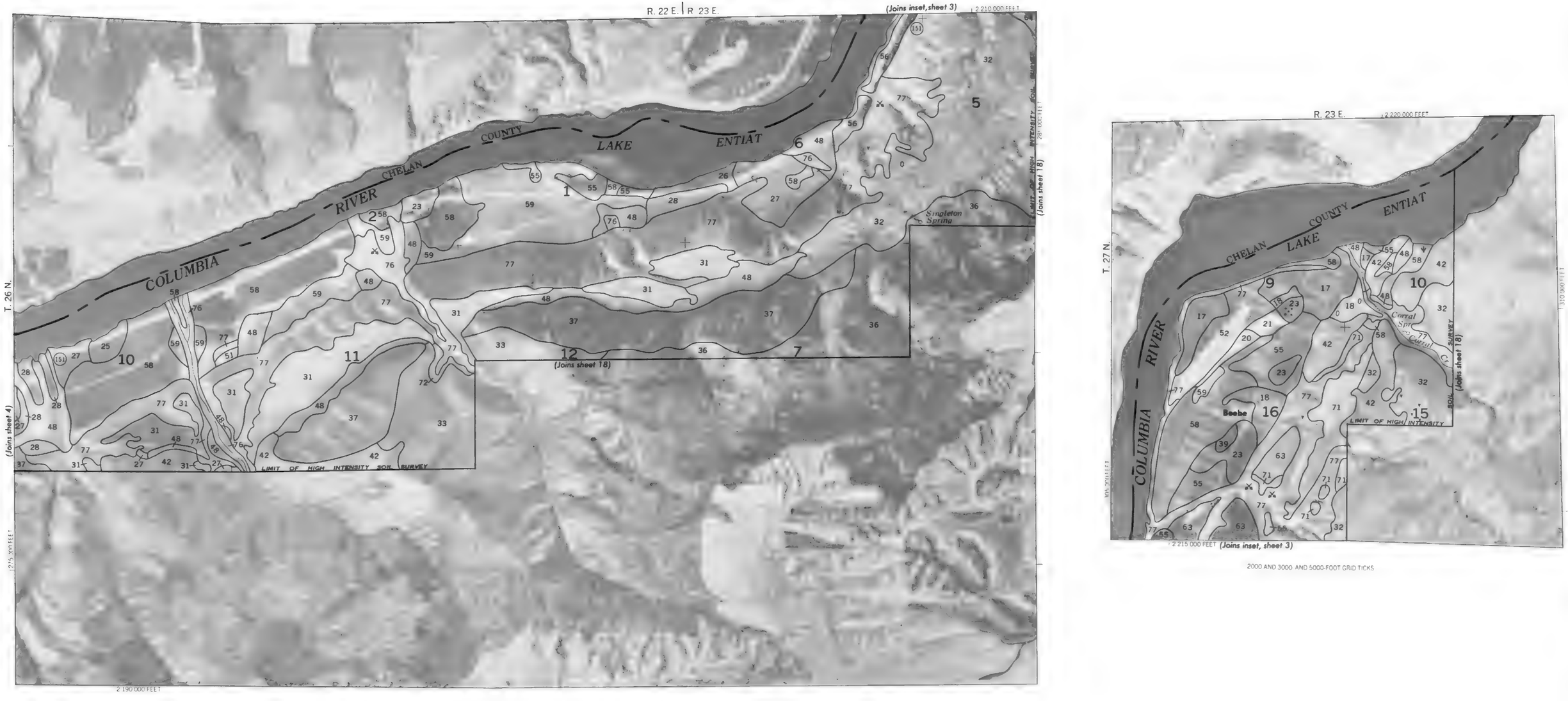
N

2 MILES

2 KILOMETERS

SCALE 1:24 000


4
N
2 MILES
2 KILOMETERS
SCALE 1:24 000
2 155 000 FEET
285 000 FEET
R. 21 E.
R. 22 E.
T. 26 N.
LAKE CHELAN
CHELAN COUNTY
COLUMBIA RIVER
ENTIAT COUNTY
LIMIT OF HIGH INTENSITY SOIL SURVEY
(Joins sheet 18)
(Joins sheet 5)
(Joins sheet 6)
(Joins sheet 18)
275 000 FEET
2 185 000 FEET

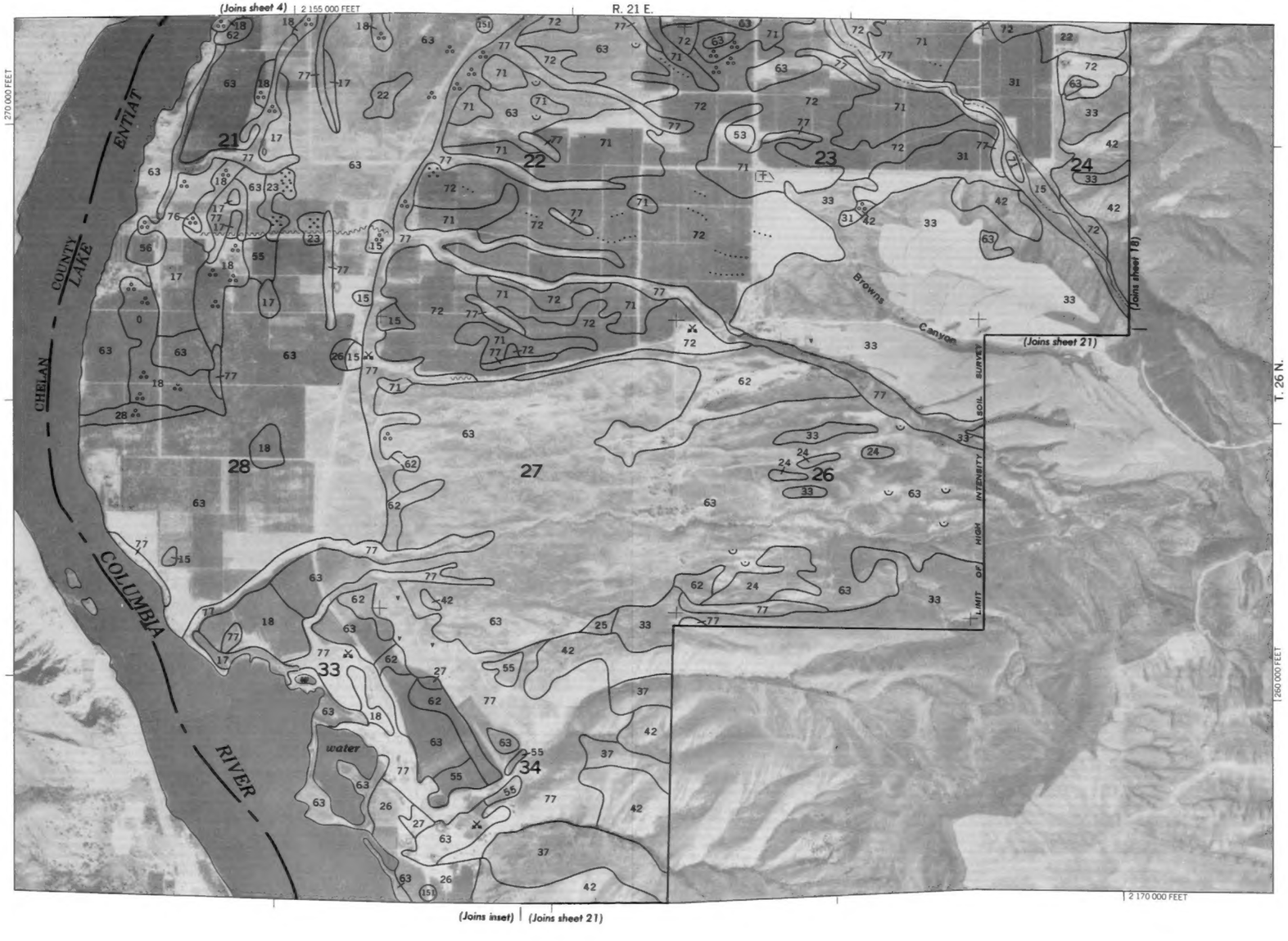

R. 22 E.
R. 23 E.
(Joins inset, sheet 3)
2 210 000 FEET
T. 26 N.
COLUMBIA RIVER
CHELAN COUNTY
LAKE ENTIAT
Singleton Spring
(Joins sheet 18)
(Joins sheet 4)
LIMIT OF HIGH INTENSITY SOIL SURVEY
2 190 000 FEET
T. 27 N.
Beebe
Corral Spr.
Corral Cr.
2 220 000 FEET
2 215 000 FEET (Joins inset, sheet 3)
2000 AND 3000 AND 5000-FOOT GRID TICKS
N
2 MILES
2 KILOMETERS
SCALE 1:24 000

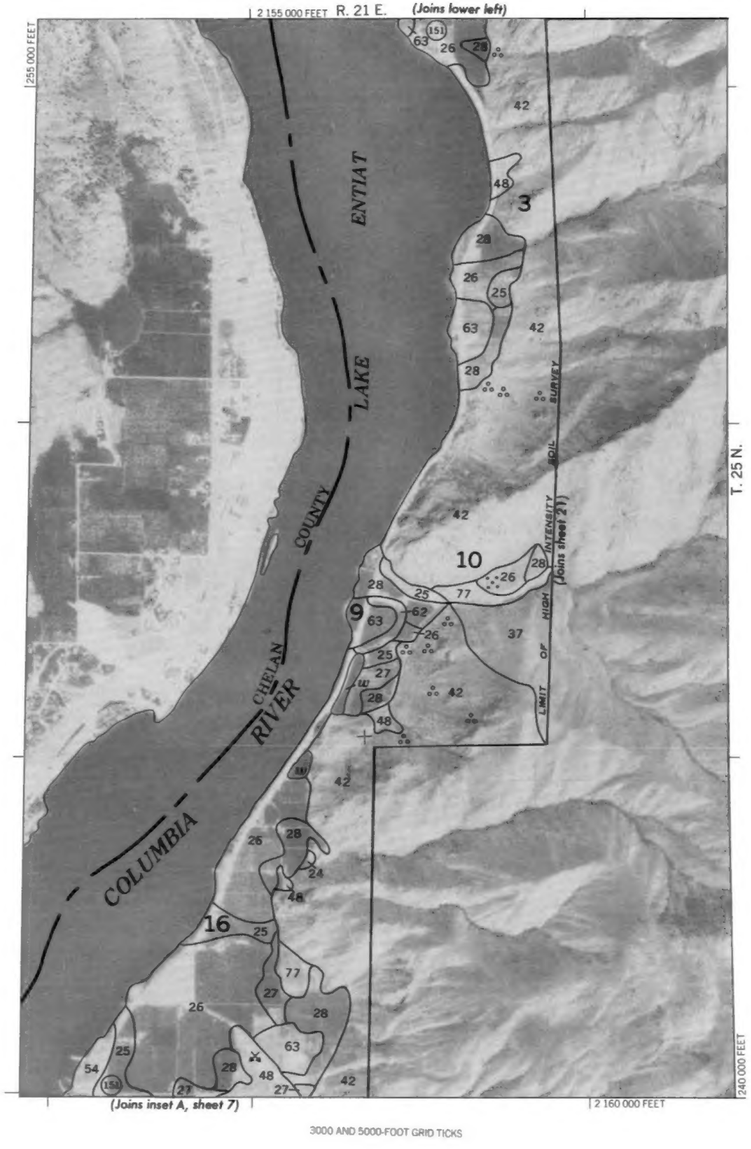
6

N

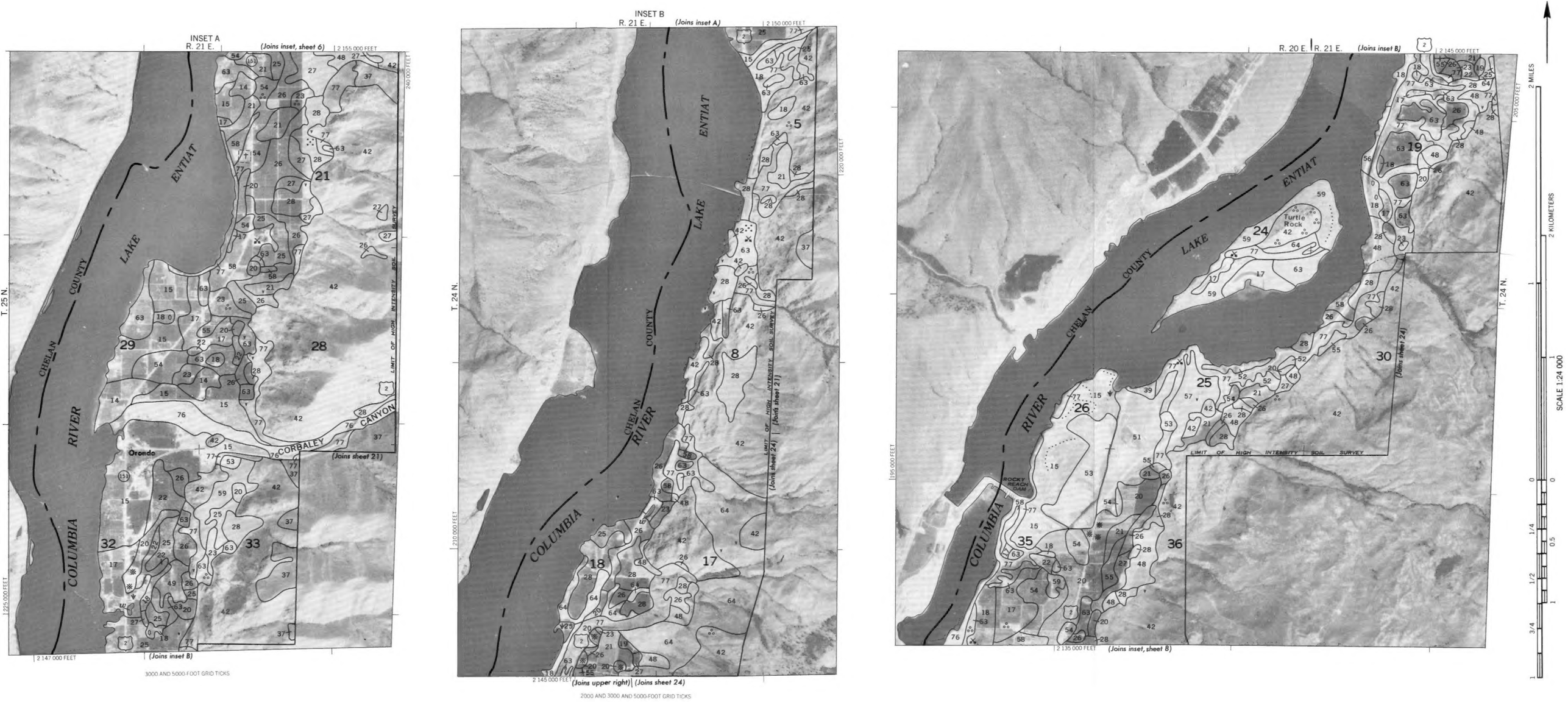
2 MILES 1 0 1 2 KILOMETERS

SCALE 1:24 000





3000 AND 5000-FOOT GRID TICKS


INSET A
R. 21 E.
(Joins inset, sheet 6)
2 155 000 FEET
240 000 FEET
ENTIAT
LAKE
COUNTY
CHELAN
RIVER
COLUMBIA
LIMIT OF HIGH INTENSITY SOIL SURVEY
CANYON
CORBALEY
Orondo
(Joins sheet 21)
T. 25 N.
225 000 FEET
2 147 000 FEET
(Joins inset B)
3000 AND 5000-FOOT GRID TICKS
INSET B
R. 21 E.
(Joins inset A)
2 150 000 FEET
220 000 FEET
T. 24 N.
210 000 FEET
(Joins sheet 21)
(Joins sheet 24)
2 145 000 FEET
(Joins upper right)
(Joins sheet 24)
2000 AND 3000 AND 5000-FOOT GRID TICKS
R. 20 E.
R. 21 E.
(Joins inset B)
2 145 000 FEET
205 000 FEET
Turtle Rock
ROCKY REACH DAM
195 000 FEET
2 135 000 FEET
(Joins inset, sheet 8)
(Joins sheet 24)
N
2 MILES
2 KILOMETERS
SCALE 1:24 000


8
N
2 MILES
2 KILOMETERS
SCALE 1:24 000
2 130 000 FEET
(Joins inset)
R. 20 E.
175 000 FEET
T. 23 N.
160 000 FEET
2 140 000 FEET
(Joins sheet 9)
CHELAN COUNTY
COLUMBIA RIVER
LIMIT OF HIGH INTENSITY SOIL SURVEY
(Joins sheet 24)
FANCHER FIELD
Canyon
Sand
22
23
25
26
27
34
35
36
55
2 130 000 FEET
(Joins sheet 7)
R. 20 E.
R. 21 E.
T. 24 N.
T. 23 N.
190 000 FEET
160 000 FEET
2 140 000 FEET
(Joins upper left)
CHELAN COUNTY
COLUMBIA RIVER
LIMIT OF HIGH INTENSITY SOIL SURVEY
(Joins sheet 24)
Flats
Baker
2
10
11
14
15
35
36

SOIL SURVEY OF DOUGLAS COUNTY, WASHINGTON — SHEET NUMBER 9

9

N

2 MILES

2 KILOMETERS

SCALE 1:24 000